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ADIUVANTIBUS

G. L. FARKAS, V. FRENYÓ, T. HORTOBÁGYI, P. JUHÁSZ-NAGY, I. MÁTHÉ, S. SÁRKÁNY, T. SIMON, R. SOÓ, B. ZÓLYOMI

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The papers of volume 19 : 1—4 (1973) of Acta Botanica were published in honour of Academic Dr. Dr. h. c., R. Soó. A part of the papers sent for the special volume could not be published there, owing to limited size. The present volume contains these papers (mostly the works of Hungarian authors) additionally.

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BRYOGEOGRAPHISCHE FORSCHUNGEN IM KARSTGEBIET DES BIHAR-GEBIRGES

Von

Á. BOROS — L. VAJDA

BOTAN. ABT. D. UNGAR. NATURHIST. MUSEUMS, BUDAPEST

(Eingegangen am 1. Januar, 1973)

The Mts. Bihar are one of the most interesting parts of the Transylvanian Carpathians. Their very rich and interesting phanerogamous flora was studied first by PÁL KITAIBEL, then by A. KERNER. Its bryoflora was investigated by M. PÉTERFI (1908). The karstic regions of the area were almost inaccessible in the time when PÉTERFI made his researches, and so they were mostly unknown. It was GY. CZÁRÁN who discovered and studied first (1905) the karstic phenomena of the range.

Of these imperfectly known and very interesting karstic phenomena — the moss flora of which was studied by the authors during their Transylvanian journey in 1972 — we describe in the present study the moss flora of the following localities: 1. the ice-cave of Skerisora, 2. the karstic spring of Isbuc-Ponor and its swaller in Padisi, 3. the rocky pass of the river Meleg-Szamos, 4. the Drake Cave of Oncsásza, 5. and Suri-cave of Peşteră.

1. Die Eishöhle von Skerisora (= Scărişoara) »Gyecár« genannt

Diese unweit vom Ursprung des Aranyos = Arieş Flusses gelegene (auch Ghietariu genannt) wurde von A. SCHMIDL im Jahre 1863 (p. 31.) als die herrlichste Eishöhle der ehemaligen Monarchie bezeichnet. Seitdem wurden im Dachsteingebirge die Eisriesenwelt und andere Eishöhlen entdeckt, ob also die Meinung SCHMIDLS auch heute noch haltbar ist mag dahingestellt bleiben. Die Eishöhle von Skerisora mit ihrer — nach Schmidl — 47 m (25 Klafter) tiefen und oben 57 m (30 Klafter) breiten, senkrechten Aven (Schacht) ist eine ganz eigenartige Erscheinung. Sie ist weder auf der Spezialkarte 1 : 75000, noch auf der Karte 1 : 25000 oberhalb Skerisora (= Scărişoara) vermerkt. Das ist die Ursache dafür, dass ihre Höhe über dem Meeresspiegel unterschiedlich und falsch angegeben wurde. Tatsächlich liegt die Öffnung ca. 1150—1200 m. ü. d. M. Auf dem Grund dieses Schachtes liegt das ganze Jahre Schnee, die Temperatur ist auch im Sommer kaum über 0°C (bis 5°C). Die eigentlichen grossartigen Eisbildungen beginnen noch tiefer, also schon im Dunkel, wohin die Moosflora nicht eindringt.

Am Eingang des Schachtes ist die Flora fast die gleiche wie im Freien, es leben dort noch Sträucher und einige andere Blütenpflanzen. *Doronicum columnae* und *Chrysosplenium alternifolium* bringen hier noch Blüten, tiefer aber bleiben sie steril. Das *Chrysosplenium* dringt in dem Höhlenschacht zwischen

Brachythecium rivulare sehr tief hinab, aber nur sterile Blättchen suchen das geringe Licht mit ihrer Oberfläche wie kleine, runde Scheiben. Die Moosflora unterscheidet sich am obersten Niveau wenig von jener der bewaldeten Kalkfelsen, tiefer aber entwickelt sich bald eine regelrechte Höhlenflora. Wir haben zusammen 48 Moosarten festgestellt. Das ist die grösste Zahl, die wir in den Höhlen der Karpaten gefunden haben, und etwas mehr als in den an Moosen reichsten Höhlen der Béla-Javorinaer Tatra-Höhlen. A. ZMUDA fand in der an Moosen reichsten Alabaster-Höhle 38 Moosarten.

Am tiefsten und noch in Massen dringt *Brachythecium rivulare* in die Eishöhle von Skerisora vor, uzw. bis zum Grunde des Schachtes, wo man schon auf Schnee steht; es bildet allein eine Massenvegetation in einer eigenartigen Schattenform. Ebenda trifft man auf noch etwas *Mnium marginatum* und auch andere grosse *Mnium*-Arten, endlich spärlich auch die *Timmia norvegica*. Tief senken sich auch die Arten *Amblystegium jungermannioides*, die *Orthothecium*-Arten, *Isopterigium pulchellum* hinab. Sie verschwinden erst bei der stark verminderten Beleuchtung, sind also nur bis zur ersten Hälfte des Schachtes zu finden. *Cololejeunea* und *Chrysohypnum halleri* fanden wir dagegen nur im Eingang. Hier erhält die Vegetation mittags noch etwas Sonnenlicht. Intersiveres Licht reflektieren in die Höhle nur vorübergehend die weissen Wolken. Von etwa der halben Tiefe ab dringt nur ganz weniges diffuses Licht ein, auf den Grund des Schachtes, wo schon Schnee liegt, auch davon nur ganz wenig.

Die gefundenen Moosarten sind die folgenden:

Conocephalum conicum B*
Metzgeria pubescens V
Pedinophyllum interruptum B V
Leiocolea muelleri B V
Blepharostoma trichophyllum B V
Scapania aequiloba B
Cololejeunea calcarea B V
Fissidens cristatus B V
Ditrichum flexicaule B
Distichium montanum B
Dichodontium pellucidum B V
Tortella tortuosa (c. sporog.) B
Gymnostomum rupestre V
Hymenostylium curvirostre V
Barbula rigidula B V
Grimmia apocarpa B
Pohlia cruda B
Bryum uliginosum (= *cernuum*) B V (c. sporog.)
B. alpinum var. *viride* V
Mnium punctatum B
Mnium affine var. ± *integrifolium* B V
M. seligeri B V
M. medium V
M. rugicum V
M. marginatum B
M. lycopodioides V
Bartramia oederi B V
Timmia bavarica B V
T. norvegica B V
Leskea nervosa B
Cratoneurum filicinum B V
Hygrohypnum palustre B V
Amblystegium jungermannioides B V
A. riparium B
Campylium (= *Chrysohypnum*) *halleri* V
Calliergon cuspidatum V
Drepanocladus uncinatus B V
D. aduncus var. *polycarpus* f. *capillifolius* V
Brachythecium rivulare B V
B. glareosum V
B. laetum V
Cirriphyllum cirrosum var. *molendoi* B V
Eurhynchium swartzii var. *abbreviatum* B V
Orthothecium rufescens B V
O. intricatum B V
Isopterigium pulchellum B V
Ctenidium molluscum B V
Rhytidiadelphus triqueter B

* Abkürzungen. B: gesammelt von Á. BOROS, V: von L. VAJDA

Interessant sind unter ihnen die subalpinen borealen und höhlenliebenden Arten *Bryum uliginosum* (=*cernuum*, c. sporog.), *Timmia bavarica*, *T. norvegica*, *Amblystegium jungermannioides*, *Cirriphyllum cirrosum* var. *molendoi*, *Orthothecium rufescens*, *O. intricatum*, *Isopterigium pulchellum*.

Orthothecium rufescens ist das einzige Moos, das aus der Höhle aufgrund einer Mitteilung von M. PÉTERFI (1908) schon bekannt war. Für das Gebirge neu sind *Mnium rugicum*, *Timmia norvegica*, *Cirriphyllum cirrosum v. molendoi*. Das meist in Höhlen lebende kleine *Amblystegium jungermannioides* (*A. Sprucei*) ist literatisch gleichfalls neu für das Bihar-Gebirge, Á. BOROS bekam aber die Art vor von einigen Jahren aus einer anderen Eishöhle des Bihar, der Focul viu oder Eskimo-Höhle. Sie wurde dort von unserem jungen Freund L. HAJDU gesammelt. *Bryum uliginosum* (= *cernuum*) ist in den Karpaten sehr selten, aber eben von Bihar-Gebirge, vom Ördöngős = Ordenkuşa-Tal durch M. PÉTERFI schon mitgeteilt (1908).

In der Nähe der Eishöhle hat A. KERNER, später L. SIMONKAI schon in den siebziger Jahren des vorigen Jahrhunderts botanisch geforscht. M. PÉTERFI teilte viele interessante Moosarten aus der Umgebung der Eishöhle, besonders vom Tale Ördöngős-völgy neben Skerisora mit. A. BORZA erwähnt einige Blütenpflanzen in einem populären Artikel (1918) auch vom Eingang der Eishöhle selbst (z. B. *Pulmonaria rubra*, *Cirsium erisithales*, *Valeriana tripteris*, *Geum rivale*, *Chrysosplenium alternifolium*, *Veronica urticifolia* usw.)

2. Izbucul Ponorului

Im Ponor oder Ponor-Circus südöstlich vom Zentrum der Hochebene Padis entspringt im nördlichen Teil eine grosse Karstquelle, die Izbuc (Vízkelet). Der Ponor-Bach fliesst auf einer kurzen felsigen und bewaldeten Strecke, dann durcheilt er die unbewaldete Poiană Ponor (Ponor-Wiese), und nach ca. 1 1/2 km Lauf ergiesst sich die ganze Wassermenge des Baches in einem trichterförmigen Erdspalt (Ponor, ung. Víznyelő).

Die Karstquelle Izbuc, ungarisch »Vízkelet«, kommt aus einer Höhle mit ziemlich grossem ca. 2 m hohem Portal (ung.: »száda«). In dieser Höhle kommen auch einige höhlenliebende Moose vor. In der Höhle und an ihrem Eingang wurden beobachtet:

Solenostoma triste B V
Pedinophyllum interruptum V B
Gymnostomum aeruginosum B
Eucladium verticillatum B
Cinclidotus minor (= *fontinaloides*) c. sporog. B V (wenig)
Thamnobryum alopecurum B
Cratoneurum commutatum B

Der Bach der Karstquelle (Vízkelet) durchfliesst eine von Fichten-Mischwald bedeckte Halde von Kalkfelsblöcken, auf denen lauter calciphile Moose leben; nur auf umgestürzten morschen Fichtenstämmen findet sich eine

reiche, mehr azidophile Moosflora mit interessanten Elementen. Das interessanteste Moos ist hier die *Mylia taylori*, die in Siebenbürgen schon sehr selten ist. Sie ist atlantisch, vom Westen gerechnet, nur bis Maramaros häufig. (BOROS — VAJDA 1967, 1968). Die Glieder dieser Moosflora auf morschem Holz, auf morschen Baumstrünken, auf bemoosten Kalkfelsen, endlich am Ufer des Baches sind die folgenden:

Conocephalum conicum B
Preissia quadrata Sz
Pellia fabbroniana Sz B
Lophozia ascendens V
Pedinophyllum interruptum V
Cephalozia leucantha V
Solenostoma triste Sz V
Jungermannia leiantha V
Scapania umbrosa B
S. aequiloba V
Anastrophyllum michauxi B V
Chiloscyphus sp.
Bazzania trilobata Sz.
Ptilidium pulcherrimum B
Mylia taylori B V
Fissidens cristatus B
Distichium montanum c. sporog. Sz
Dichodontium pellucidum var. *flavescens* (c. sporog.) B V
Dicranum flagellare V
D. logifolium B
Dicranodontium denudatum B V
Tortella tortuosa Sz
Bryoerythrophyllum recurvirostrum V
Georgia pellucida B
Plagiobryum Zieri c. sporog. B V
Pohlia cruda Sz
Bryum elegans V
Mnium punctatum Sz B
M. spinosum B Sz
M. orthorrhynchum B Sz
M. undulatum Sz
Lescuraea incurvata B Sz V
Cratoneurum commutatum Sz
Hygrohypnum palustre (c. sporog.) B Sz
Chrysohypnum halleri (c. sporog.) V
Brachythecium rutabulum Sz B
B. salebrosum V
Eurhynchium rusciforme B
Isopterigium elegans B
Hypnum lindbergii V
Ctenidium molluscum Sz V

Hier hat einige Wochen vor uns unser Freund T. A. SZABÓ für uns Moosmaterial gesammelt. Es ist oben mit »Sz« bezeichnet.

Dieselbe Stelle, Izbucul Ponor, wurde bryologisch vor einigen Jahren von St. PÁLL studiert (1963). In seiner Enumeration kommt u.a. *Hookeria lucens* vor, die wir vergebens gesucht und selbst an jenen Stellen nicht gesehen haben, wo man ihr Vorkommen hätte erwarten können. Sie ist ein acidophiles Moos, welches in den Karpaten äusserst selten vorkommt. Sie lebt im Fogarascher Gebirge in drei benachbarten Tälern, in der Nähe des Bulea Wasserfalles mit *Blindia acuta*, *Schistostega pennata*, *Campylopus fragilis*, *C. piriformis*, *Leucobryum juniperoideum*, *Plagiothecium undulatum* (Boros—Vajda 1967). Ferner hat sie noch einzelne Standorte in Maramaros, in Südtranssilvanien und in den Nordkarpaten. Auch die Begleitelemente, die die *Hookeria* im Fogarascher Gebirge begleiten, sind hier, in diesem Karstphänomen, ganz fremd.

Da wir bisher keine Belege für St. PÁLLs Fund erlangen konnten, müssen wir das Vorkommen dieser Art, die ein sehr auffallendes westliches Element des Bihar-Gebirges wäre, bezweifeln, trotzdem an anderen Stellen im Bihar-Gebirge auf Kieselunterlage auch Sphagneten, Massen von *Plagiothecium undulatum* usw. vorhanden sind.

Das bisher als Endemit der Alpen aufgefasste *Heterophyllium lorentzianum* haben wir im Dragan-Tal im Bihar-Gebirge entdeckt (BOROS u. VAJDA

1967). Dieser Fund weist auf einen westlichen Zug des Bihar-Gebirges hin; hier im Ponor-Circus fehlen aber die acidophilen Verhältnisse, die für *Hookeria* güngstig wären, vollständig.

Sobald der Bach die Ponor-Wiese (Poiană Ponor) durchquert hat, verschwindet er in einem Erdspalt. Im Frühjahr, bei der Schneeschmelze ist der Erdspalt nicht imstande, die grossen Wassermengen aufzunehmen es bildet sich vorübergehend ein Teich. Sein Wasserstand ist genau begrenzt, weil das sogenannte Vránica-Felstor, sobald das Wasser des Teiches seine Schwelle erreicht, alle weiteren Wassermengen — nach V. MÁTYÁS (1939) — verschlucken kann. Der höchste Wasserstand des Frühjahrs-Teiches ist den ganzen Sommer über sichtbar, uzw. eben an der Massenvegetation des Wassermooses *Cinclidotus minor* (= *fontinaloides*), welches hier auch mit Sporogon vorkommt. Die Grenze der Massenvegetation des *Cinclidotus* bildet eine ausgeprägte waagrechte Linie. Merkwürdigerweise kommen hier keine andere Wassermoose oder andere Wasserpflanzen vor, nur auf den etwas höher stehenden, beschatteten Kalkfelsen finden sich u. a. auch interessante subalpine Moosarten. Wir sammelten hier folgende Arten:

Preissia quadrata V B
Conocephalum conicum B V
Metzgeria furcata B
Leiocolea muelleri V
Scapania aequiloba V B
Cololejeunea calcarea V
Solenostoma atrovirens V
Distichium montanum (c. sporog.) B
Ditrichum flexicaule V
Gymnostomum rupestre V
Dichodontium pellucidum V B
Hymenostylium curvirostre v. *scabrum* V
Barbula fallax V
Cinclidotus minor (c. sporog.) V B
Grimmia apocarpa B
Mniobryum albicans B
Bryum pallens Sz B
Mnium undulatum V B
M. orthorrhynchum V
M. marginatum B
Timmia norvegica V B
Leskea catenulata V
Myurella julacea V B
Climacium dendroides V
Chrysohypnum protensum V
Hypnum lindbergii B
Ctenidium molluscum B
Rhytidiadelphus squarrosus var. *calvescens* B V

Unter dem Niveau des Wasserspiegels des Frühjahrs-Sees leben nur triviale Arten, wie z. B. *Barbula fallax*, *Mniobryum albicans*, *Bryum pallens*, *Grimmia apocarpa*, *Hypnum lindbergii* usw. Die interessanten Felsenmoose leben ohne Ausnahme auf den Felsen, die sich etwas über das Ufer des intermittierenden Teiches erheben. Die interessantesten subalpin-borealen resp. subarktischen Arten sind hier *Timmia norvegica* und *Myurella julacea*.

Das Vorkommen der Myrinia pulvinata in den Karpaten

Bevor man die Stelle erreicht, an der die Waldlichtung »Poiană Ponor« endet, nahe am Ufer dieses intermittierenden Teiches trifft man auf das auffallendste Moos des Bihar-Gebirges. Hier hat L. VAJDA das Moos *Myrinia pulvinata* (Wahlenb.) Schimp. mit Sporogone gefunden. In den Rasen sind Stengeln von *Anomodon viticulosus* eingemengt. *Myrinia* ist eine nördliche,

ausgesprochen boreale, arktische Art, die — nach Angaben von ARNELL (bei LIMPRICHT p. 745) — bloss in Sibirien, besonders im arktischen Gebiet des Jenisej häufig ist. Sie hat in Lappland, Grossbritannien, Finnland, Schweden, Norwegen (NYHOLM p. 407.) verstreute Standorte, früher sehr selten auch in Frankreich (Saône et Loire, Jura) und in den italienischen Alpen (Venetia alta), häufiger — nach Podpěra — in Latvia, im Ural, dann in Nordamerika, im Norden von Kanada, in Britisch Kolumbien und New Brunswick. Nach LIMPRICHT und NYHOLM wurde sie in Südtirol nicht wieder gefunden. Letzterer wäre der dem Bihar-Gebirge am nächsten gelegene Fundort. Diese boreale Art kommt hier ganz isoliert, ohne andere arktische Arten vor.

3. Die Schlucht des Meleg Szamos

Nicht weit von der Quelle des Meleg Szamos (Warmer Szamos, Someşul Cald) konnten wir die Schlucht erreichen mit der der wunderbare Karstkomplex »Szamosbazár« — beschrieben von GY. CZÁRÁN, — endet. Bis zu dieser Stelle führt heute eine forstwirtschaftliche Strasse (drum forestilor). Die weiteren prächtigen Karsterscheinungen erscheinen für Á. BOROS wegen seiner angegriffenen Gesundheit und seiner geschwächten Kräfte vorläufig unerreichbar. Diese Schlucht ist aber so reich, dass sie wahrscheinlich die meisten interessanten Moose des Karstphänomenkomplexes enthält.

Bevor man die Schlucht (ung. »Kőköz«) erreicht, findet man am linken Ufer des Meleg Szamos eine Quellen-Höhle, (ung. »Vízkelet«), nach V. MÁTYÁS Herdetau genannt. Der Höhle entspringt reichlich Wasser. An der Ausbruchsstelle findet sich bloss *Cratoneurum commutatum* in Mengen, mit den meist wenig bedeutenden Arten.

Marchantia polymorpha V
Pedinophyllum interruptum V
Scapania aequiloba V
Gymnostomum aeruginosum V
Barbula vinealis ? V
Grimmia apocarpa B
Mnium orthorrhynchum V
Cratoneurum filicinum B
C. commutatum V B
Chrysohypnum halleri V
Eurhynchium rusciforme B V

Nur in der eigentlichen Schlucht an der sehr wenig Wasser spendenden, aber hübschen Miniquelle, »Pikkolo Quelle« genannt, sind die Felsen reich an subalpinen Moosarten. Wir konnten folgende einsammeln:

Preissia quadrata V
Conocephalum conicum B
Metzgeria pubescens V B
Solenostoma triste V B
Plagiochila asplenioides V
Pedinophyllum interruptum V B
Leiocolea muelleri V B
Scapania aequiloba V B
Plagiobryum zieri V B (c. sporog.)
Bryum pallens B
Mnium marginatum B
Bartramia norvegica (c. sporog.) V B
B. oederi (c. sporog.) V B
Myurella julacea V B
Lescuraea incurvata V
Hygrohypnum palustre B

Radula lindbergiana V
Cololejeunea calcarea V B
Fissidens cristatus V B (auch auf morscher Baumrinde)
Distichium montanum (c. sporog.) V B
Dichodontium pellucidum V
Gymnostomum aeruginosum V B
Tortella tortuosa B
Barbula tophacea V
Mnium orthorrhynchum V
Cirriphyllum piliferum V
Eurhynchium swartzii var. *abbreviatum* V
E. striatum V
Rhynchostegium murale B V
Orthothecium intricatum V
O. rufescens B
Plagiothecium Roeseanum (c. sporog.) V
P. undulatum V B
P. laetum var. *tenellum* V
Isopterigium pulchellum V B

Unter diesen deuten *Plagiobryum zieri*, *Bartramia norvegica*, *Myurella julacea*, *Lescuraea incurvata*, *Orthothecium rufescens*, *O. intricatum* auf den subalpinen Charakter des Standortes hin.

4. Die Drachen-Höhle von Oncsásza

Die Drachen-Höhle von Oncsásza (Oncasa) auch Peşteră Smeilor, Sárkány-barlang genannt, befindet sich oberhalb des Ponor-Tales, gegen Biharfüred = Stâna de Vale hin. Die Höhle ist altbekannt und wegen ihrer reichen fossilen Knochenreste, Fundort mehrerer kompletter Höhlenbären-Skelette, berühmt. Auf der Spezialkarte 1 : 75000 ist die Höhle vermerkt, aber so falsch angegeben, dass man sie — nach V. MÁTYÁS (1936., pag 85) — nach der Karte nicht auffinden kann.

Die Höhle hat ein mässig (ca. 2m.) hohes Portal (Abbildung bei V. MÁTYÁS p. 87) und liegt nach Angabe der Spezialkarte 1 : 75000 in 1312 m Höhe über dem Meeresspiegel. Sie liegt ziemlich hoch oberhalb der neugebauten forstwirtschaftlichen Strasse (drum forestilor) und konnte nur von L. VAJDA in Begleitung eines Einwohners, der als Führer diente, erreicht werden. L. VAJDA traf im Innern des Höhleneinganges folgende Moose:

Leiocolea muelleri
Seligeria pusilla
Eucladium verticillatum
Mnium stellare
Bartramia oederi (c. sporog.)
Amblystegium jungermannioides
Eurhynchium swartzii var. *abbreviatum*

Unter ihnen ist das höhlenbewohnende *Amblystegium jugermannioides*, mit arktisch-alpinem Charakter bemerkenswert; es wurde im Bihar-Gebirge schon in der dritten Höhle gefunden.

5. Peşteră Suri im Tale des Feirei-Baches

Am rechten Ufer des Baches Feirei oder Firei, Viri, eines oberen Nebenbaches des Meleg Szamos (Someşul Cald), schon im ehemaligen Komitat Kolozs gelegen, wo die einstige Wassersägemühle stand, öffnet sich eine

imposante Höhle, Peşteră Suri genannt. Sie hat zwei Vorhallen und eine ohne Leiter nicht erreichbare obere Öffnung. Bei hohem Wasserstand fliesst das Wasser durch die Höhle; wenn der Wasserstand sinkt, tritt unten, kaum etwas über dem Bachufer eine hübsche Quelle zutage.

In den Vorhallen leben einige höhlenbewohnende Moosarten. Es wurden hier gesammelt:

Solenostoma triste B V
Leiocolea muelleri B
Pedinophyllum interruptum V
Dichodontium pellucidum B V
Gymnostomum aeruginosum B
G. aeruginosum var. *cavernicola* B
Grimmia apocarpa B
Cratoneurum commutatum B
Amblystegium riparium f. *leptophylla* B
Hygrohypnum palustre B V
Brachythecium rutabulum B
Isopterigium pulchellum V

Im Bache:

Fontinalis antipyretica B V

Am tiefsten dringt in die Höhle *Gymnostomum aeruginosum* ein. Es kommt in einer *Molendoa sendtneriana*-ähnliche Form vor; diese ökologischen Formen entsprechen der f. *cavernicola* Boros (Bot. Közlem. 32. 1935. p. 108).

*

Abschliessend möchten wir unseren Kollegen V. MÁTYÁS und L. SCHÖNVISZKY für ihre Informationen und für die teilweise Überlassung der einschlägigen geographischen und späleologischen Literatur herzlichst danken.

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NOTES ON THE LEAF ANATOMY OF THE BRACHYPODIUM PINNATUM SPECIES-COMPLEX

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The anatomical structure of the species *Brachypodium pinnatum* and *rupestre* were examined on the basis of 56 leaf epidermises and cross-sections. The author inferred that parallel with the differencies in the external morphological characteristics, the two taxa differ from each other also in regard of the anatomical structure of the leaf. The configuration of the sclerenchyma tissue, the appearance and form of the silica bodies, the picture of the epidermis show definite differences, hence the specific separation is justified.

Introduction

When elaborating the *Brachypodium* species for Volume V. of R. Soó's book entitled "Synopsis systematico-geobotanica florae vegetationisque Hungariae" I have re-examined, on the basis of herbaria, the *Brachypodium pinnatum* form species from Hungary and the Carpathian Basin. In addition to the identifications resting on external morphology the anatomical structure of the leaf was also considered, since the species *pinnatum* and *rupestre* are recently separated from each other also on the basis of their histological structures (SCHOLZ 1968). The relevant results are summarized in the present study.

The somatic chromosome number of *Brachypodium pinnatum* is $2n = 28$, according to several authors (KATTERMANN 1930, TISCHLER 1934, LÖVE and LÖVE 1944, GARDÉ 1951, TATEOKA 1954, 1956, HUBBARD 1954, LÖVE and LÖVE 1961). Concerning *Brachypodium rupestre*, no chromosome number is published in the literature. Until recently it has been included under *pinnatum* (as a subspecies or variation), so presumably, it was not examined separately.

In the earlier home floral publications, and also in foreign literature, *B. rupestre* was considered a variety with glabrous palea of *B. pinnatum*. The latter does have a form with a glabrous palea (f. *leiostachys* Soó), thus a large part of Hungarian data (Soó mscr.) probably refers to this, since the palea of *B. rupestre* can also be hairy (f. *scholzii* Soó 1971; cf. Scholz 1968). I saw f. *leiostachys*, in the above herbaria, from the Buda and Pilis hills, from Mts Vértes and Bakony, from the Balaton region, the Mt Mecsek and Kőszeg, from Zala (Söjtör), Nyíregyháza, as well as from several points of Slovakia and the Bánát.

The specific separation of the two taxa appears to be indicated not only on the basis of differences between the external morphological characteristics, but also by the leaf anatomical structure. The leaf anatomy of the genus *Brachypodium* was discussed by several authors; for example, LOHAUSS (1905), OEÉ-LABY (1898), DUVAL-JOUVE (1875), GROB (1968), LEWTON-BRAIN (1904), STRECKER (1913), GÜNZEL (1921), PRAT (1932, 1936), BURR and TURNER (1933), etc. In the anatomical handbook of the *Gramineae*, METCALFE (1960) provides a short characterization of the leaf anatomy of some *Brachypodium* species. SCHOLZ (1968) deals with the taxonomical problems of *pinnatum* and *rupestre* by pointing out deviations of a specific level. However, the anatomical data and characterization published by him are not confirmed by our examinations, so these will be discussed in details as follows.

Material and method

Several hundred individuals of the herbarial material* of the form species *Brachypodium pinnatum* were examined as to their morphological characteristics (shoot, leaf, florescence, etc.), then epidermis prepared from the basal leaves of the selected type-specimens. The material of 56 epidermis were taken in each case from the central area of the band leaf so that the abaxial and adaxial surfaces should lie outstretched in the section. The cross-sections were also prepared from the mid-area of the basal leaf in its entire breadth. The epidermis were taken with the method described by UJHELYI (1954), the cross-sections by hand-cutting and bleaching (SÁRKÁNY—SZALAI 1964).

Discussion and results

On the basis of the leaf structure, *Brachypodium pinnatum* and *rupestre* belong to the so-called Festucoid type.

The leaf of *pinnatum* is densely covered with long hairs and short setae. The epidermal cells on the adaxial and abaxial surfaces are $\pm$ uniform, with stomata. The leaf blade shows thinner and thicker ribs, hence not evenly ribbed. On the surface of the leaf, at the groves generally 6—10 large and thick-walled cells with ample cavities are observable, the so-called bulliform cells. In the opinion of some authors, these cells controll the rolling or folding of the leaves by deflation and inflation, owing to changes in the turgor. Stomata occur on both sides of the leaf; on the abaxial side along side the bulliform cells, on the adaxial side on the two sides of the sclerenchymatous zone. The cells of the parenchymatous tissue are large, polygonal, multiseriate and concentric around the veins. The sclerenchymatous tissue develops at the ribs. The sclerenchymatous cells with strongly thickened walls develop at the thicker ribs, around various larger vascular bundles in a thick, columnar

* The material elaborated derive from the Herbarium of the Hungarian Natural History Museum collection of the Phytotaxonomical and Phytogeographical Department as well as the Botanical Garden of the LORÁND EÖTVÖS University; Botanical Institute of the LAJOS KOSSUTH University, Debrecen, and the private collection of ÁDÁM BOROS.

form, or by joining the vascular bundle in a thick cap-shaped formation on the adaxial surface of the leaf, while on the abaxial surface they take the shape of a packed column. The scl. tissue either does not develop in the smaller ribs, or the cells occur in the thickness of only a few, or as a row of cells, under the epidermis (see. Figs 1a, b). Strongly developed, thick sclerenchymatous bundles are appeared on both margins of the leaf (see the cross-section; Fig. 2A).

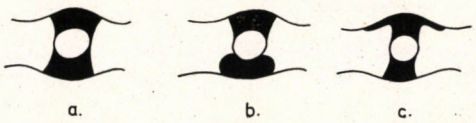

Fig. 1. Schematic drawing of the sclerenchyma in leaf cross-section: *a, b Brachypodium pinnatum, c Brachypodium rupestre*

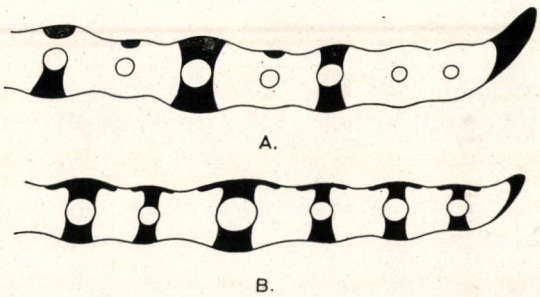

Fig. 2. Part of leaf cross-section, schematic drawing, with vascular bundles and sclerenchymata. *A Brachypodium pinnatum, B Brachypodium rupestre*

The vascular bundles at the ribs are externally surrounded by two concentrically arranged cell rows (METCALFE 1960). The outer one is the so-called external bundle sheath consisting of larger cells of parenchymatous origin, while the inner one is the so-called internal bundle sheath consisting of cells with or slightly lignified walls and of sclerenchymatous origin.

The phloem and xylem tissues occur within the bundle sheaths. The metaxylem lies on the two sides of the wood body, while the protoxylem on the opposite side of the phloem (Fig. 3).

The epidermal pictures (Photos 1, 2, 3): On the adaxial side, the epidermal cells under the parenchyma tissue are large, long, with alternately sinuous cell walls, from the almost straight through the slightly or minutely sinuous to the highly sinuous walls. Stomata occur in one row each near the sclerenchymatous zone. The epidermal cells on the abaxial side are $\pm$ of equal size with those of the adaxial surface, while above the parenchymatous tissue the large, cavernous, bulliform cells join the epidermis cells. On each of the two sides of these thick-walled bulliform cells a row of stomata extends.

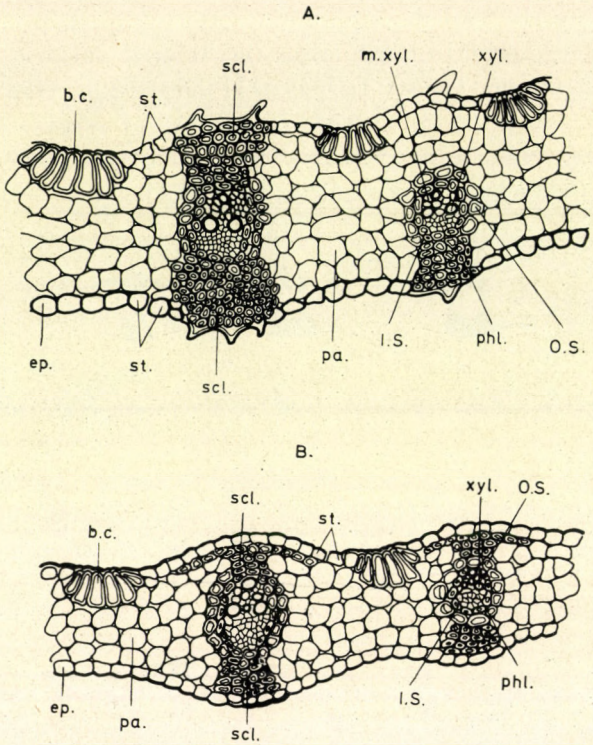

Fig. 3. A Part of leaf cross-section in *Brachypodium pinnatum; B* part of leaf cross-section in *Brachypodium rupestre*; b.c. = bulliform and colourless cell; ep. = epidermis; I.S. = inner bundle-sheath; m.xyl. = metaxylem; O.S. = outer bundle-sheath; pa. = parenchyma; phl. = phloem; scl. = sclerenchyma; st. = stoma; xyl. = xylem;

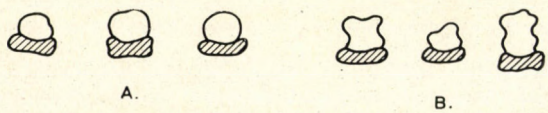

Fig. 4. Cork cell and silica brody types. *A Brachypodium pinnatum; B Brachypodium rupestre*

In the sclerenchymatous zone the long cells are smaller, narrower, their walls strongly sinous (tortuous) and thickened. The short cell row consists of cork cells and silica bodies. The cork cells are about half as big as the silica bodies their side adjacent to the silica bodies is concave. The shape of the silica bodies is flatly circular, oval or rounded tetragonal, with a high focuss (Fig. 4A). The epidermis is densely covered with setae and long hairs, the latter mainly in the sclerenchymatous zone.

The leaf of *Brachypodium rupestre* is sparsely covered with minute hairs, there are no or very few long hairs.

The epidermal cells are small, with strongly thickened external cell walls on the adaxial side, without stomata. On the abaxial side the epidermal

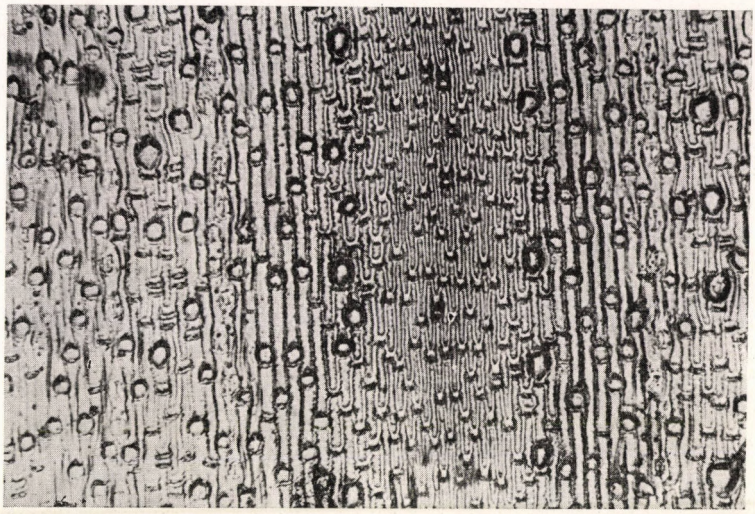

Photo 1. Br. pinnatum, part of adaxial skin (M: 6.3×6.3)

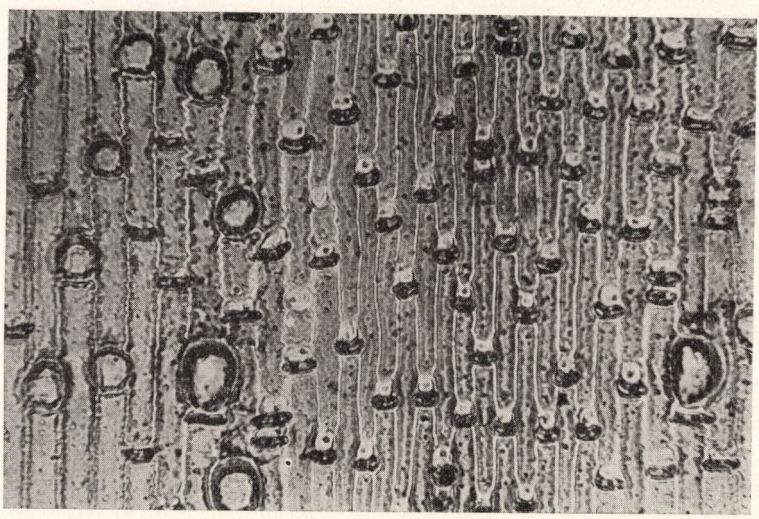

Photo 2. Br. pinnatum, part of adaxial skin (M: 6.3×16)

cells are thin-walled; above the parenchymatous tissue, in the groowes large, cavernous thick-walled, in general 6—8 bulliform cells occur, with an adjacent row of stomata. The cells of the parenchymatous tissue are bi—triseriate, arranged concentrically around the vascular bundles, and generally containing chlorophyll. The cells of the sclerenchyma tissue are arranged at the ribs columnarly above and below the vascular bundles so that they stretch in one row at the epidermis on the abaxial side to the right and to the left, as it were in a T-shape (Figs 1c and 2B), in every vascular bundle (whether large or

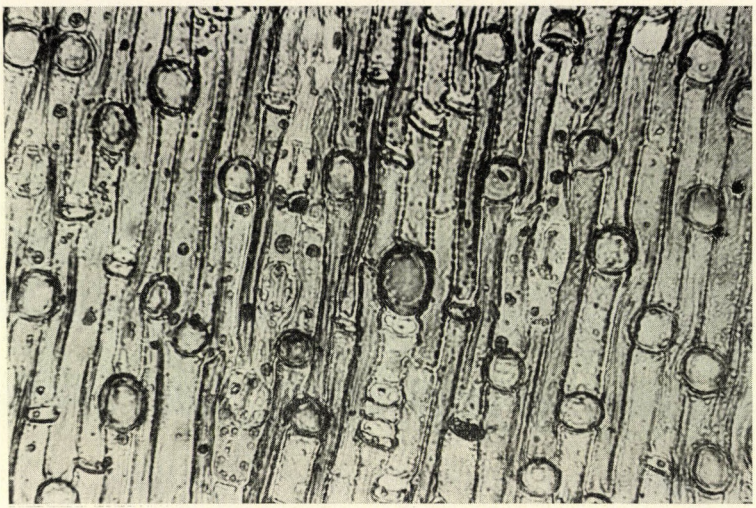

Photo 3. Br. pinnatum, part of adaxial skin (M: 6.3×16)

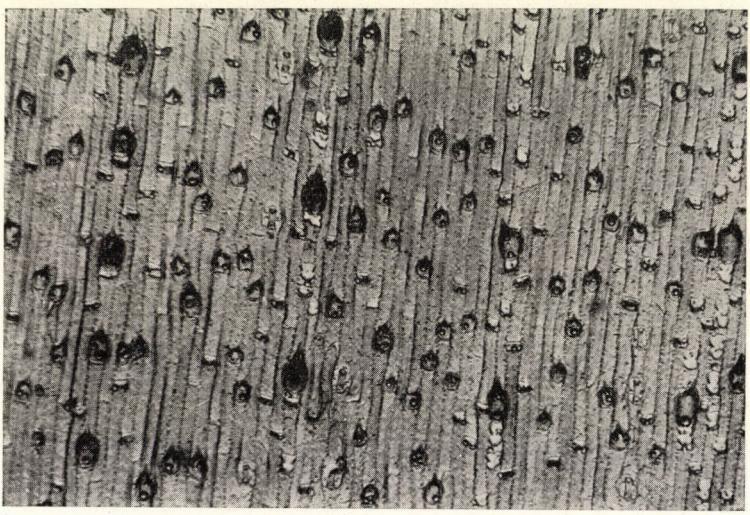

Photo 4. Br. rupestre, part of adaxial skin (M: 6.3×6.3)

small). On the two margins of the leaf the sclerenchymatous bundle is smaller and narrower than in *pinnatum*. The vascular bundle consists also here of larger cells and is of parenchymatous origin, and it is surrounded with a smaller, sclerenchymatous cell row of strongly lignified walls the external and internal bundle sheaths.

The epidermal picture (Photos 4 and 5): The epidermal cells are smaller, narrower, their walls almost straight or only slightly sinuous. No

stomata on occur the adaxial side of the leaf, while on the abaxial side they appear in rows. In the sclerenchymatous part the long cells have slightly sinous walls. In the ribs the corkcells are small, thin, about 2—3 times smaller than the silica bodies, their sides adjacent to the silica bodies are concave.

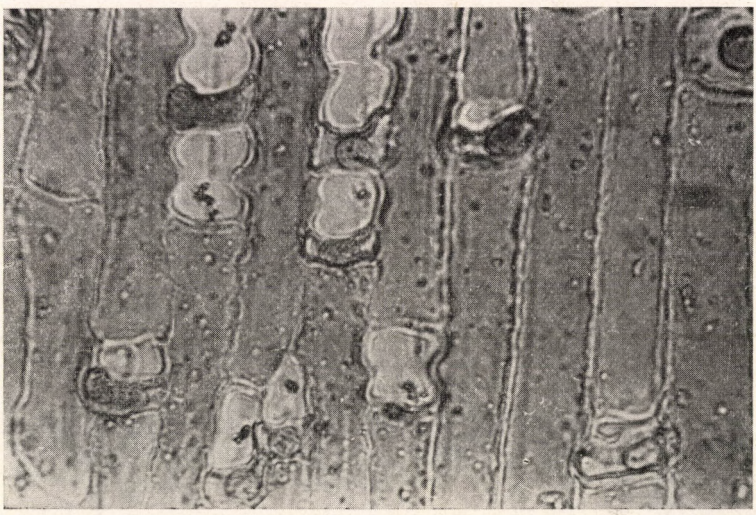

Photo 5. Brachypodium rupestre, part of adaxial skin (M: 6.3×40)

The silica bodies are tetragonal, with rounded corners, medially constricted, or mostly elongate and multiply constricted with a low focuss (Fig. 4B). Short setiform hairs appear in the sclerenchymatous zone.

Accordingly, leaf anatomical differences can be pointed out between *Brachypodium pinnatum* and *rupestre*, hence the specific separation of the two taxa is justified. As regards the anatomical characterizations published in SCHOLZ's study (1968), in our opinion they are not acceptable, because the epidermal cells of *pinnatum* show rather variously sinuous walls while the silica bodies are circular or rounded quadrangular, which in SCHOLZ would be characteristics of *rupestre*. The drawing published for *pinnatum* in SCHOLZ rather refers to our *rupestre*. The formation of the sclerenchymatous bundles in the ribs is also characteristic, well separable in the two species. In connection with this I should like to remark that LOHAUSS (1905) relegates the *Brachypodium* taxa into two groups, based on leaf anatomy. To one group belong, for example, *pinnatum* and *silvaticum*, where the leaf is relatively thin, with few adaxial veins of a clearly definable but not an expressly outstanding shape. The other group contains *mucronatum* and *ramosum*, where the leaves have conspicuous adaxial veins. LOHAUSS mentions that the sclerenchyma develops in this group in a T-shape. Therefore our *B. rupestre* also belongs to this group.

On the basis of the re-examined herbarial material it can be stated that *Brachypodium pinnatum* is widely distributed in Hungary and in the Carpathian Basin. Not so *B. rupestre*, an Atlanto-Mediterranean species, which, on the basis of the material examined is known to occur around Fiume, Yugoslavia from the collections of: BLATTNY: Novi; DEGEN: Sevcsica; SIMONKAI: Kontrida, localities nearest to Hungary. In Hungary, *Br. rupestre* was collected in two localities: Zákány and the Mts. Bakony (Kab-hegy) in the Transdanubia (the collections of KÁROLYI and PILLITZ).

Acknowledgement

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DIE AGROSTIO-QUERCETUM ROBORI-CERRIS-WÄLDER DER KLEINEN UNGARISCHEN TIEFEBENE

Von

I. CSAPODY

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A peculiar form of frame soils, the so-called Cseri soils, developed on the Pliocene and Pleistocene gravel terraces of the NW Hungarian plains (Arrabonicum). In impermeable pseudogleic layer and a cemented gravel level of varying thickness characterize these soils. Their water regime is varying: moist in autumn and spring, but dust-dry and cracked in the vegetational period. Their characteristic woods Turkey eak forests mixed with pedunculate oak, formerly named by the author as *Quercetum robori-cerris arrabonicum*. In the present study the new forest association described as *Agrostio-Quercetum robori-cerris*. The first tabular elaboration of the association is also presented here. It is shown that the association belongs in the *Quercion pubescenti-petraeae* group within the series *Quercetalia pubescentis* among its many devastated-ruderal species, *Agrostis tenuis, Festuca rupicola, Briza media, Poa angustifolia* and *Calamagrostis epigeios* are type-formating ones. In the floristical composition of the association, xerophyllous, mesohygrophyllous and acidophyllous elements participate. It appears as mass occurences of *Juniperus communis* in the open clearings perpetuate the traces of grazing during several centuries. The new association meets with the nearly related *Deschampsio-Quercetum robori-cerris* in the area of the Praenoricum, and with the association *Asphodelo-Quercetum robori-cerris* in the floral district of the Praeillyricum.

Die jungpliozänen und pleistozänen Schotterterrassen der Kleinen Ungarischen Tiefebene (E. SZÁDECZKY-KARDOSS 1938, 1941, 1947) — pflanzengeographisch Arrabonicum genannt — sind ausgedehnte und höchst charakteristische Bildungen der Ur-Raab und ihrer heutigen Nebenflüsse (Répce, Ikva, Marcal und Gyöngyös). Diese Schüttschotter erreichen einen ihrer Schwerpunkte auf dem Schotterplateau von Iván, am linken Ufer des Répce-Flusses, innerhalb der Gemeindegrenzen von Iván, Csapod, Pusztacsalád, Újkér und teilweise Röjtökmuzsaj-Sopronkövesd bzw. auf der am Ikva-Fluss entlang gelegenen Schotterrrterasse innerhalb der Gemeindegrenzen von Petőháza, Fertőszentmiklós, Süttör und teilweise Hegykő, Hidegség. Ein anderes Zentrum ihrer typischen Erscheinung liegt auf dem zwischen den Flüssen Raab und Marcal sich hinziehenden Kemeneshát: sie treten im Bezirk von Kenyeri, Kemenesszentpéter, Kemeneshőgyész und Kemenesmagasi bis Celldömölk, von hier sodann am transraabischen Lauf des Gyöngyös-Flusses entlang in der Richtung von Bögöte, Pápóc, Vép, Vassurány und Kőszegpaty bis Puszta- und Nemescsó auf. In einer milderen, weniger gebundenen Form kommen sie sogar südlich von Szombathely, in der Umgebung von Pornóapáti, Nárai, Ják, Szentpéterfa und Egyházasrádóc vor. Auch ohne weitere eingehende Darlegung erweist sich also die Feststellung als richtig, dass sich »nirgends im Lande, ja selbst in Europa nur an einigen Stellen so viel Schotter auf einem zusammenhängenden Gebiet findet wie in der nordwestlichen Hälfte Transdanubiens und in der Kleinen Ungarischen Tiefebene. Der haselnuss-, nuss- oder eiförmige, abgerundete Schotter ist unmittelbar an der Oberfläche oder unter einen dünnen Deckschicht überall aufzufinden« (SZÁDECZKY 1941); seine Ausdehnung wurde von BENCZE auf 17 000 ha, von STEFANOVITS dagegen auf 6 000 ha geschätzt.

Auf dieser Schotterdecke entstanden die in der gesamten bisher veröffentlichten Literatur (STEFANOVITS, JÁRÓ) ohne ausreichende Gründe zu den schotterigen Skelettböden gezählten, in Wirklichkeit jedoch als selbständiger genetischer Bodentyp zu betrachtenden »Cseri-Böden« (I. BABOS, P. BENCZE, P.

STEFANOVITS, Z. JÁRÓ, P. MAGYAR, I. CSAPODY — J. NEUWIRTH), die ihren Charakter dem wechselnden Wasserhaushalt verdanken. Die ungünstige physikalische Struktur stammt aus der hart verdichteten Schotterschicht unter dem oft kaum 20 cm dicken A-Horizont. Die Schotterschicht übertrifft an einigen Stellen die Mächtigkeit von 1 m. Dieser Schotter ist besserenfalls — besonders in den linsenförmigen Senkungen — von einer wasserdichten pseudogleyigen Schicht überlegert, die zur Zeit der Schneeschmelze, des Herbstregens oder des Regenmaximums im Sommer mit Wasser erfüllt ist und die Oberfläche mit stagnierendem Wasser überflutet, so dass in den im Sommer trockenen, schrundig-rissigen Senkungen für mehrere Wochen ein ungangbares Wildwasserland entsteht (P. MAGYAR, KOVÁTSITS). Die Wechselfolge von Überschwemmung und staubtrockenem Zustand verlieh dem Boden den diskrepanten Charakter eines Wechselwasserhaushalts.

Zu den obigen edaphischen Gegebenheiten gesellt sich ein ungünstiges Klima. Die Niederschlagsmenge im Durchschnitt von 40 Jahren betrug 646 mm, bei Csapod sogar nur 609 mm (HAJÓSY); ausserdem sind Herbstregen auffallend selten und der November-Dezember trocken. Den kontinentalen Charakter unterstreichen die 10°C übersteigende mittlere Jahrestemperatur und die Zahl der Sommer bzw. Hitzetage (65 bzw. 15) noch zusätzlich (BACSÓ), da diese Werte in den westlich oder südlich gelegenen Gebieten weit höher sind.

Es ist leicht zu verstehen, dass unter solchen Boden- und Klimaverhältnissen die Stieleiche (*Quercus robur*) mit der Zerreiche (*Qu. cerris*) natürliche Mischbestände bildet. Ich habe diesen Wald erstmalig 1969 unter dem Namen *Quercetum robori-cerris arrabonicum* beschrieben, seine kurze Charakterisierung hat — zusammen mit einer Aufzählung der typischen und dominierenden Arten — aufgrund meiner Angaben R. SOÓ veröffentlicht (1971). Die vorliegende Studie enthält das gesamte Aufnahmematerial, die kurze ökologische Charakterisierung und die zönosystematische Klärung der neuen, die Verhältnisse besser widerspiegelnden und *Agrostio-Quercetum robori-cerris* benannten Waldassoziation.

Von den besten mit entgegengesetztem ökologischem Anspruch auftretenden Eichenarten kann das massenhafte Vorkommen von *Quercus robur* dadurch erklärt werden, dass allein die Stieleiche den luftlosen Zustand in den durch die anhaltende Überschwemmung verdichteten Bodenhorizonten zu vertragen vermag und dass nur sie mit ihrem Pfahlwurzel auch die zementierte Schotterschicht durchdringen kann. Der extremen Trockenheit der seichten und nährstoffarmen oberen Schicht kann sich dagegen nur die Zerreiche anpassen. *Quercus pubescens* und *Qu. petraea* erscheinen nur akzidentell. Höchstens einige Pionierbaumarten — wie *Populus tremula*, *P. canescens* und die im Aussterben begriffenen *Ulmus minor*-Gruppen vermischen sich mit ihr. Ihre Bestände sind auenartig, die Kronenschicht ist nie geschlossen, die Baumhöhe niedrig und der Holzertrag spärlich.

Die dichte Strauchschicht besteht aus dornigen Sträuchern, die an die einstige Nützung als Hutewald und Jagdrevier erinnern (*Crataegus monogyna*, *Prunus spinosa*, *Pyrus pyraster*, *Rosa canina*), und nur an den fruchtbareren, geschlosseneren Flecken treten *Ligustrum vulgare*, *Euonymus europaeus* und *Cornus sanguinea* auf. Die typischste formationsbildende Art der Strauchschicht st der Wacholder (*Juniperus communis*), dessen Massen mit ihrem Formen-

Abb. 1

reichtum auf den Flächen zwischen den Beständen an Bugac erinnern und die von A. KERNER (1863) besungene, unvergessliche Stimmung der Sandhügel im Zwischenstromland zwischen Donau und Theiss wachrufen (vgl. Abb. 1.) Es kann als bestimmt angenommen werden, dass das massenhafte Vorkommen des Wacholders auf dem 400 ha umfassenden Gebiet des Iváner Nagyerdő (Grosser Wald) die Folge des uralten Beweidens (CSAPODY) und der Gradmesser starker Kultureinflüsse ist (Soó). Es ist jedoch zu befürchten, dass die für die Nutzung allein geeignete Föhre (*Pinus silvestris*) als Mittel des Eingriffs des Menschen in die Umgestaltung der Natur das schöne, in seinem heutigen Zustand noch annähernd natürliche Vegetationsbild in kurzer Zeit zerstören wird.

Die stark heterogene Krautschicht ist artenreich (162 Arten + 13 Moose), wenn auch in diese Zahl auch die 43 akzidentellen Arten miteinbegriffen sind. Unter den 96 Arten mit höherem Konstanzwert dominieren

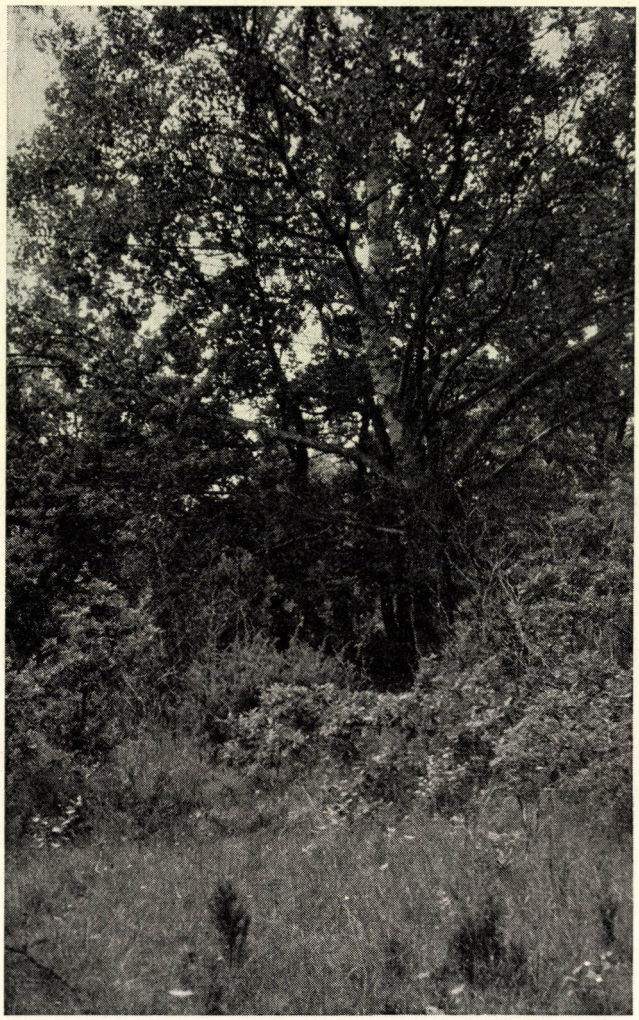

Abb. 2

Agrostis tenuis, *Festuca rupicola*, *Briza media*, *Poa angustifolia*. An Stellen an denen Nadelbäume angepflanzt wurden, tritt auch *Calamagrostis epigeios* auf. Es sind ausnahmslos Typen bildende Arten (s. Tabelle 1). Die ökologische Diskrepanz tritt insofern auch bei den Krautarten zutage, als sich die (wichtigeren) xerophilen Arten (*Achillea millefolium* IV, *Agrostis tenuis* V, *Aira caryophyllea* III, *Briza media* IV, *Calamintha clinopodium* IV, *Centaurea pannonica* V, *Hypericum perforatum* IV, *Potentilla arenaria* und *P. argentea* III, usw.) mit mesophilen Arten (mit einem Konstanzwert von I—II, z. B. *Carex hirta*, *Deschampsia caespitosa*, *Galium palustre*, *Gratiola officinalis*, *Juncus conglo-*

Tabelle 1

QUERCETEA PUBESCENTI-PETRAEAE. Quercetalia pubescentis: Quercion petraeae: Quercetum petraeae-cerris Soó 57.
Agrostio-Quercetum robori-cerris (Csapody 69) Csapody 73

a) *agrostio-brizetosum* 1—8. (*typicum*) b) *agrostio-festucetosum* 9—10. c) *agrostio-poetosum* 11—12. d) *agrostio-calamagrostistosum* 13—16.

			a.								b.		c.		d.				A–D	K
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Aufnahme-Nr.			439	440	444	447	486	488	479	462	463	487	450	451	461	464	465	466		
Höhe über NN (m)			110	130	135	130	120	110	120	110	110	110	120	120	110	110	110	110		
Exposition			—	—	SW	SW	—	SO	—	—	—	SO	—	—	W	—	—	—		
Neigungswinkel in Graden			—	—	3°	3°	—	2°	—	—	—	2°	—	—	2—3°	—	—	—		
Artenzahl der Einzelaufnahme			63	42	52	63	29	51	40	39	78	33	34	36	32	31	22	31		
A) Deckungsgrad der Baumschicht in %			50	20	—	20	25	40	30	40	40	45	50	80	45	40	50	30		
B) Deckungsgrad der Strauchschicht %			40	30	5	75	50	30	50	50	25	50	25	15	20	50	—5	20		
C) Deckungsgrad der Krautschicht in %			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
Charakter- u. Trennarten der Assoziation:																				
		A																		
Med	MM	*Quercus cerris* (*Quercetea p.-p., P. Qu.*)	+	+	+—1	1	+	4	1—2	4	1	1	1	2	4	—	—	—	+—4	V
Eu(-med)	MM	*Quercus robur* (*Quercetea r.-p., Fr. Carp.*)	2	+	+—1	4	5	5	4—5	3	+	3	+	4	3	—	—	—	+—5	V
		B																		
Eu(-med)	M	*Crataegus monogyna* (*Querco-Fagetea*)	2	+	—	3	—	+	1	1	3	1	+	1	+	1	+	4	+—5	V
Cp.	M	*Juniperus communis* (*Querc., Nardo-Call.*)	4	3	+	4	2	3	5	2	+	2—3	1	1—2	—	r	+	4	+—5	V
Med	M	*Quercus cerris* (*Quercetea p.-p., P. Qu.*)	—	—	+	—	—	—	(+)	2	+—1	—	—	—	1	—	—	—	+—2	II
Eu(-med)	M	*Quercus robur* (*Quercetea r.-p., etc.*)	—	—	—	—	—	—	—	+	—	—	—	+	—	+	—	—	+	I
Eu(-med)	M(H)	*Rosa canina* (*Quercetea p-p.*)	+	+	+	1	+	1	+	—	+	+	—	+	—	+	+	+	+—1	V
		C																		
Cp	H	*Agrostis tenuis* (*Nard.-Call.*)	3—4	4	3—4	4—5	4	4—5	5	4	4—5	4—5	4—5	2—(5)	3—4	5	5	4	2—5	V
Eua(-kt-m.)	H	*Festuca rupicola* (*Festucion -Querc.*)	+	+	1	1	—	1	1	1—2	3—4	2	—	+	+	—	+	—	+—4	V
Med	M	*Quercus cerris* (*Quercetea p—p., P. Qu.*)	—	+	—	+	1	+	—	—	1	+	—	—	—	—	—	—	+—1	II
Eu(-med)	M	*Quercus robur* (*Quercetea r.-p.,*)	—	+	—	—	—	+	—	—	+	+	+	—	—	—	—	—	+	II
Charakterarten d. Kl. **Quercetea pubescenti-petraeae** (incl. + **Pino-Quercetalia-**Arten):																				
		A																		
Med	MM	*Pinus nigra* cult.	—	—	—	—	—	—	—	—	+	—	—	—	—	3—4	5	5	+—5	II
Eua	MM	*Populus canescens (Salic., Fagion)*	+	—	—	1	—	—	—	—	1	—	+	—	—	—	—	—	+—1	I
		B																		
Med	M	*Pinus nigra* cult.	+	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	+	I
Eu-med	M	*Prunus spinosa* (resp. *Prunion)*	r	—	+	2	1	1	—	—	+	2	1—2	+	+	+	—	—	r—2	IV
Eu-med	M	*Pyrus pyraster*	—	—	—	—	+	—	—	—	(+)	—	+	—	+	—	—	r	+	II
		C																		
Eua(-med)	H	*Carex montana* (resp. *Quercion*)	—	—	—	—	—	—	+	—	+	—	—	—	—	—	—	—	+	I-
Eu(-med)	N(Ch)	*Genista tinctoria* ssp. *elatior*	—	—	r	—	—	—	—	—	—	+	+	—	—	—	—	—	+	I
Eua(-med)	H	*Viola hirta*	—	—	1	+	—	—	—	+	—	—	—	+	—	—	—	—	+	II

Akzidentelle Arten: *A:* — *B:* Eu(submed)-MM *Malus silvestris* (12: +), Eua-MM *Pinus silvestris* cult. (10: +—(3)); Med-MM *Quercus pubescens* (1: +) u. × *Quercus pubescens* × *petrae* (9: 1—2)- *B:* Eua-M *Pinus silvestris* (1: 1), Submed(-em)- M *Rosa gallica* (1: +). — *C:* Submed-H *Lathyrus latifolius* (9: +), Submed-(em)-M *Rosa gallica* (1: +), Eua-TH(H) *Verbascum nigrum* (13: +), Eu(-med)—H(Ch) *Veronica officinalis* (resp. *Pino-Quercetalia*, 4: +—1, 11: +), Eu(med)-H *Vicia cassubica* (13: +).

Querco-Fagetea Klassen-Charakterarten:																						
		A																				
Eua(-med)	MM	*Populus tremula*	1	—	+	+	—	—	—	—	1	—	+	—	—	—	—	—	+—1	II		
		B																				
Eu(-med)	M	*Euonymus europaeus*	—	+	(+)	—	—	—	+	—	—	—	—	—	—	—	—	—	+	I		
Eu(atl.-med)	M	*Ligustrum vulgare*	—	—	—	+	1	+—1	1	—	(r)	1	+	+	2	—	—	—	r—2	III		
Eua(-med)	M	*Populus tremula*	+	+	+	+	—	—	—	—	+	—	—	—	—	—	—	—	+	II		
Eu(-med)	M	*Ulmus minor*	—	—	—	—	—	—	(+)	—	1	+	+	+	—	—	—	—	+—1	II		
		C																				
Med(em)	H	*Calamintha clinopodium* (→*Quercetea*)	—	—	—	—	1	+	—	+	+—1	—	+	+	1	1	(+)	+—(1)	+—1	IV		
Eua(-med)	H	*Cruciata glabra*	—	—	—	+	—	—	—	—	1	—	+	—	—	—	—	—	+—1	I		
Em	H(G)	*Dactylis polygama*	—	—	—	—	—	—	—	—	+	—	—	—	2	1	—	+	+—2	II		
Cp	H	*Fragaria vesca* (+*Epilobietea*)	+	—	(1)	1	—	—	—	(+)	—	—	+	—	—	2	1	+	+—2	III		
Eu(-atl.-med)	M	*Ligustrum vulgare*	—	+	—	—	+	—	—	—	—	—	+	—	+	—	—	—	+	II		
Eua	H	*Scrophularia nodosa*	—	—	—	—	+	—	—	—	—	—	+	1	+	—	—	—	+—1	II		
Med(eu)	M	*Viola alba*	—	—	—	—	—	—	—	+	+	—	—	—	—	—	—	—	+	I		

Akzidentelle Arten: *A:*—*B:* Eu(-med)—MM/M *Quercus petraea* s.l. (9: +, 13: 1). — *B:* Em-M *Carpinus betulus* (15: +), cult?; Eua-M (*Cornus sanguinea* 13:(+), Eu(med)-MM/M *Tilia platyphyllos* s.l. cult. (*Fagetalia* s. str., 1: +—1, es ist nicht kennzeichnend!); *C:* Eurosib. (med)-H *Astragalus glycyphyllus* (resp. *Quercetea*, 13: +), Pont.-med—H *Lysimachia punctata*, (+ *Epilobietea*, 14: 1—2,), Eu(-med)-H *Viola silvestris* (11- +).

Festuco- Brometae Klassen-Charakterarten (incl. *Fest.-Brometea* + *Quercetalia pubescenti-petraeae*-Arten°)																						
°Eua(-med)	H	*Agrimonia eupatoria*	—	+	+—1	+—1	—	+	—	+	+	+	—	—	—	2—3	—	1	+—3	III		
°Submed-pont.	H	*Asperula cynanchica*	—	—	—	—	—	—	+	2	2—3	—	—	—	—	+	—	—	+—2	II		
°Eu(-kt-med).	H	*Cynanchum vincetoxicum*	r	—	—	—	—	+	—	+	r	—	—	—	—	—	—	—	r—+	II		
Eu(med)	H	*Dianthus carthusianorum*	—	—	—	1	—	+—1	—	—	(+)	+—1	—	—	—	—	—	—	+—1	II		
Alp.-balk.	N	*Dorycnium germanicum* (→*Quercetea*)	—	—	—	+	—	+	—	—	+	—	—	—	—	—	—	—	+	I		
Eua(-med)	H	*Filipendula vulgaris* (= *hexapetala*)	—	—	—	—	—	—	—	—	+	—	—	—	—	+	—	—	+	I		
°Med(-em)	H	*Geranium sanguineum*	+	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—	+	I		
°Eua(-med)	H	*Hypericum perforatum*	+	+	(+)	+	—	+	—	1	2	+	—	+	1	1	—	+	+—2	IV		
°Cp	H	*Koeleria cristata* (→*Quercetea*)	—	—	+	1	—	—	—	—	+	—	—	—	—	—	—	—	+—1	II		
Eua(-kt-med)	H	*Phleum phleoides* (-*Quercetea*)	—	—	—	—	+	—	—	—	—	+—1	—	—	—	—	—	—	+—1	I		
Eua(-med)	H	*Pimpinella saxifraga* + (*Arrhenath.*)	—	—	2—3	—	—	—	—	1	—	—	—	—	+	—	—	—	+—3	I		
Cp	H	*Poa angustifolia*	2	—	—	1	—	—	—	—	—	—	2—3	3	—	—	—	—	1—3	II		
Em(-sarm)	H	*Potentilla arenaria*	—	—	+—1	—	—	+	+—1	2—3	1	—	—	—	—	—	—	+	+—3	II		
Med(em)	H	*Prunella laciniata*	+	+	+	+	—	—	—	—	+	+	—	—	(r)	—	—	—	+	III		
Eu(med)	Ch	*Sedum acre*	+	+	—	—	—	—	—	—	—	—	—	—	r	—	—	—	r—+	I		
Eu(med)	Ch	*Sedum sexangulare*	1	—	—	—1	+	1—2	1	—	+	—	—	—	—	—	—	—	+—2	II		
Eu(-kt)	TH(Th)	*Seseli annuum*	—	—	—	—	—	+	—	1	(r)	—	—	—	—	—	—	—	(r)—1	I		
°Med(em)	H	*Teucrium chamaedrys*	—	2—3	2	—	—	—	—	2	2—3	—	—	+	—	—	—	1	+—3	II		
Kt	Ch	*Thymus glabrescens* ssp. *subhirsutus*	—	—	—	1—2	—	—	1—2	1	1—2	—	—	—	—	+	—	—	+—2	II		
Eua(med)	Th(TH)	*Trifolium aureum*	+	—	+—1	—	—	—	—	—	—	—	—	—	—	+	—	—	+—1	I		

Akzidentelle Arten: *C* Em(med)-H *Anthyllis vulneraria* s. str. (*Festuco-Brometea*, 9: +), Eu(-med)-H. *Carduus acanthoides* (Unkraut, 6: +)° Em med-H *Coronilla varia* (*Quercetea* u. Gesellschaftswage, 3: +), °Eua(kt)-H *Linaria genistifolia* (*Quercetea*, 14: +), Eua(-med)-TH(Th) *Picris hieracioides* (*Arrhenatheretea*, *Chenopodietea*, etc., 14: r), Eua(kt)-H *Scabiosa ochroleuca* (9: +)

Tabelle 1, Fortsetzung

	a.								b.		c.		d.				A–D	K
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		

Tabelle I, Fortsetzung

			a.								b.		c.		d.				A–D	K
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Festucetalia valesiacae — Ordnungs-Charakterarten:																				
Eua(-med)	H	*Achillea setacea*	1	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+–1	I
Eua(-med-kt)	G	*Carex liparicarpos* (+ *Fest. vaginatae*)	1–2	–	–	+	–	1	(+)	–	–	–	–	–	–	–	–	–	+–2	II
Eua(-med)	TH(H)	*Carlina vulgaris* ssp. *intermedia*(")	–	–	r	–	–	+	–	+	+	–	–	–	–	+	–	+	+	II
Eua(-med)	TH(H)	*Centaurea micranthos*	–	+	(+)	(+)	–	–	–	–	+	–	–	–	–	–	–	–	+	II
Submed(em)	Th	*Cerastium semidecandrum*	+	–	–	r	–	–	–	–	+	–	–	–	–	–	–	–	r–+	I
Kt(eua)	H	*Fragaria viridis*	–	–	(+)	–	–	+–1	+	–	1	–	–	–	–	–	–	–	+–1	II
Kt(eua)	H	*Hieracium bauhinii* (→*Quercetalia*)	+	–	–	–	+	–	–	–	–	–	+	–	–	–	–	–	–	I
Med	H	*Sanguisorba minor* ssp. *muricata*	–	–	(+)	–	–	–	–	–	r	–	–	–	+	–	–	–	r–+	I
Em	H	*Scabiosa canescens*	–	+	–	–	+	–	–	–	–	+	–	–	–	–	–	–	+	I

Akzidentelle Arten: Eu(kt)-H *Asperula tinctoria* (2: +), Em-G(Ch) *Gypsophila arenaria* (*fastigiata* ssp. *arenaria* (2: r), Atl(-med)-Ch *Helianthemum canum* (resp. *Festucion rupicolae*) (9: +), Eua-(med)-Th *Myosotis stricta*), (1: r), Pont-med.-H *Stachys recta* (*-Quercetalia*, 4: +), Kt(eu)-H *Verbascum phoeniceum* (10:+).

Corynephoretalia (*Thero-Airion*+ und *Corynephorion*-Arten:

+Atl-med	Th	*Aira caryophyllea*	2–3	2–3	–	1–2	–	1–2	–	–	1	–	–	–	–	+	–	+	+–3	III
Eu(-med)	H	*Jasione montana*	–	+	–	–	+	–	–	–	–	–	–	–	–	r	–	r	+–r	II
K	H	*Rumex acetosella* ssp. *tenuifolius*	+	+	–	+	–	–	+	–	+	–	–	+	–	–	–	–	+	II
Eu(-kt)	Ch	*Thymus serpyllum* s.l.	+–1	1	1–2	–	–	–	–	–	–	–	–	(+)	–	–	–	–	+–2	II
Molinio-Arrhenatheretea- (incl. *Molinietalia*") -Arten:																				
K(eua)	H	*Achillea millefolium* agg.	+	1	+–1	1	+	+–1	–	1	1	+	–	–	–	–	–	1	+–1	IV
Eua	H	*Alopecurus pratensis*	–	–	–	+	–	–	–	–	–	–	–	+	–	–	–	–	+	I
Eua(-med)	H	*Anthoxanthum odoratum*	(2)–3	3	+	2–3	+	2	2	1	1–2	1	–	–	–	2	+	+–1	+–3	V
Eua	H	*Briza meda*	3–4	3	2	3	1	2	1–2	2–3	1–2	–	–	+	–	–	–	–	+–4	IV
Cp	H	*Festuca rubra*	–	+	+	+	–	–	–	+	–	–	–	–	–	–	–	–	+	II
-Cp(med)	H	*Galium palustre* (→*Magnocaricion*)	–	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–	+	I
Eua(med)	H	*Holcus lanatus* (→*Pino-Quercetala*)	+	–	–	+	–	+	–	–	–	+	–	–	–	–	–	–	+	II
-Eua(med)	H(HH)	*Juncus conglomeratus* (*Molinion*)	–	–	–	+	–	+	–	–	–	–	+	r	–	+	–	–	r–+	II
Eu(med)	Th(H)	*Linum catharticum*	+	–	+	+	–	+	–	–	–	–	–	–	–	–	–	–	+	II
K(eua)	H	*Plantago lanceolata* (*Festuco-Brom.*)	–	+	(+)	1	–	+–1	1	+	2–3	–	–	–	–	–	+–1	–	+–3	III
Cp	H	*Poa pratensis* (→*Quercetea*)	–	–	–	+	–	–	+	–	1	–	––	–	–	1–2	1	1	+–2	II
K	H	*Rumex acetosa* (*Quercetea*)	+	–	–	–	–	–	–	–	–	–	+	+	–	+	–	–	+	I
Eu(med)	H	*Sieglingia decumbens* (+*Nardo-Call.*)	1–2	1	–	2	–	1	1	+	–	+	–	–	–	–	–	–	+–2	III
Cp	H	*Vicia cracca*	–	–	+	–	–	–	–	–	–	–	–	–	+	–	–	–	+	I

Akzidentelle Arten: Med-G *Colchicum autumnale* (□: +), Em-Th *Euphrasia rostkoviana* (2: +), K-H *Potentilla reptans* (3: +), Eua-(med)-H *Ranunculus acris* (1–2: +), Eua(med)-H, *Taraxacum officinale* (gesellschaftswage u. *Chenopodio-Scleranthetea*, 4: +).

Molinio-Juncetea-Klassen-Charakterarten:

Cp	H	*Deschampsia caespitosa*	–	–	–	–	+	–	(+)	–	–	–	+	r	–	–	–	–	r–+	II
Eua(kt)	H	*Selinum carvifolia*	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	I

Akzidentelle Arten: Eua-H *Juncus effusus* (gesellschaftswage Art, 5: +), Eu(med)-Ch *Lysimachia nummularia* (gesellschaftswage Art, *Querco-Fagetea*, etc. 13: 1), Eua(med)-HH *Lysimachia vulgaris* (*Phragmitetea*, *Pop.-Alnetea*, etc. 16: +–1), Em(med)-H *Pulicaria dysentherica* (9: +

Arrhenatheretea- (incl. **Arrhenatheretalia**)-Arten:

Em(med)	H	*Arrhenatherum elatius*(*Quercetea*, *Agrost.*)	–	–	2	–	–	–	–	–	1	–	–	+	–	–	–	+	+–2	II
Em	TH	*Campanula patula*	+	+	+	+–1	–	–	–	–	–	–	–	–	–	+	–	–	+–1	II
Eu(med)	H	*Cynosurus cristatus*	1	1–	–	–	+	+	+	–	(r)	–	–	–	–	–	–	–	+–1	II
Em(med)	Th	*Euphrasia stricta*	–	–	–	–	–	+	+	1	(+)	–	–	–	–	+	–	–	+–1	II
			+	–	–	+	–	–	–	–	+	–	–	–	–	–	––	–	+	II

Akzidentelle Arten: K-H *Ajuga genevensis* (*Fest.-Brom*, *Quercetea*, etc., 4: 1), Eu(kt)-H, *Helictotrichon pubescens* (3: +), Eu-H *Scutellaria hastifolia* (10–11: r–+).

Chenopodietea (incl. **Sisymbrietalia** +**Secalietea**)-Arten:

Eua	Th	*Geranium dissectum*	–	r	(+)	–	–	–	–	–	–	–	–	–	–	+	r	+	r–+	II
Med(eua)	Th	*Setaria viridis* (*Chenopodio-Scler.*)	–	–	–	–	–	–	–	–	–	–	–	–	–	+	(+)	(+)	+	II
Adv	Th	*Stenactis annua* (*Calystegietalia*, etc.)	–1	+–1	–	1–2	–	r	–	–	r	–	–	–	–	+	1	1–2	+–2	III
Eu(med)	TH	*Verbascum densiflorum* (*-Quercetea*)	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	I

Akzidentelle Arten: K-H *Euphorbia Helioscopia* (9: +), Eu(med)-TH(H), Oxalis europaea (14: r), Eu(med)-Th *Veronica triphyllos* (Aperion *Festucetalia* 1: 1), Eua-Th *Viola arvensis* (9: +)

Gesellschaftswage-Arten:

Eua(kt)	H	*Calamagrostis epigeios* (*Ep., Mol-Junc.*)	+	–	–	–	–	+	(1)	–	+–(1)	–	–	–	2–3	3	2–(4)	2–(4)	+–4	III
Eu(med)	G	*Carex hirta* (*Mol.-Arrh., Magnocar.*,)	–	–	–	1–2	+	–	–	–	–	–	+	–	+	–	–	–	+–2	I
Em	H	*Centaurea pannonica* (*Mol.-Arrh., Fest.*)	3	+	+–1	+	+	1	+–1	1	–	+	+	–	+	+	–	+	+–3	V
Eua(med)	Th	*Centaurium minus* (*Mol.-Arrh., Querc.*,)	+	+	–	–1	–	+	+–1	–	1	+	–	–	–	+–1	–	–	+–1	III
Eua(med)	G	*Cirsium arvense* (*Chen.-Scler., Pop., Ep.*)	–	–	–	+	–	r	–	–	4	–	–	–	–	–	–	–	r–+	I
Eua(med)	H	*Dactylis glomerata* (*Fest.-Brom., MAr*).	–	–	+	+	–	–	–	–	+	–	–	–	–	–	–	–	+	I
Eua(med)	Th	*Daucus carota* (*sec.* Unkraut, *Mol.-Arrh.*)	+	–	+–1	+	1	+–1	1	1	+	+	–	–	–	+	–	+	+–1	IV
Eu(med)	H	*Eryngium campestre* (sec. Unkr., *Mol.-Arrh.*)	–	–	+	(+)	–	+	+	–	–	–	–	–	–	–	(+)	+	+	II
Kt(pont-med)	H	*Epilobium roseum* (*Calystegion, Glyc.*)	–	–	–	–	r	–	+	–	–	–	–	–	+	r	–	–	r–+	II
Eu(med)	H(G)	*Euphorbia cyparissias* (*Festuco-Brom.*)	+	+	2–3	1–2	+	1	1	1–2	2	+	–	1	–	–	+	–	+–3	IV
Eua(med)	H	*Galium mollugo* (*Arrh., Fest.-Br., Querc*)	–	–	–	–	–	+	–	–	–	+	–	+	–	–	–	–	+	I
Cp(med)	H	*Galium verum* (*Fest.-Brom., MJunc.*)	1	1	+–1	2–3	+–1	+–1	1	2–3	–	+	–	+	1	r	2	2	r–3	V
Eua(med)	H	*Hieracium pilosella* (*Fest.-Brom., Qu.*)	1	1–2	1	–	–	–	1–2	1	+	–	–	+	–	1–2	1	1	+–2	III
Eu(med)	H	*Inula britannica* (*Mol., Plant., Chen.*)	+	–	–	–	r	–	–	–	–	–	–	–	1	–	–	r	r–1	II
Eua	H	*Lotus corniculatus* (*Mol., Fest.-Br.*)	+	–	–	––	–	–	–	–	–	–	–	+	–	–	–	–	+	I
Eu	H	*Lotus tenuis* (*Fest.-Puccinell.*)	–	–	–	–	–	–	+	–	–	–	–	–	–	+	–	–	+	I
Submed(em)	H	*Luzula campestris* (*Nard.-Call.*, etc.)	2	2	1	1	–	–	–	–	–	–	1	–	–	–	–	–	1–2	II
K	H	*Mentha pulegium* s.l. (*Agr., Chenop.*)	–	–	–	–	–	–	–	–	–	+	(r)	–	1–2	–	–	–	+–2	II
Eua	H	*Potentilla argentea* (*Fest.-Brom., Qu.*)	+	–	(+)	+	–	–	+	–	1	–	–	–	–	+	–	+	+–1	II
Cp	H	*Prunella vulgaris* (*Mol.-, QuFag.*,)	–	–	+	–+	–	+	–	+	–	–	–	–	–	–	–	–	+	II
Cp	H	*Trifolium arvense* (*Fest.-Brom., Secal.*)	–	–	–	–	–	–	–	+–1	2	–	–	–	–	–	–	–	+–2	I
Eua(med)	Th																			

Akzidentelle Arten: *A:* Adv.-MM *Robinia pseudoacacia* (15: +). — *B:* Adv.-M. *Acer Negundo* cult. (16: +), Adv.-M *Ailanthus glandulosa* cult. (16:+). — *C:* Südeur.-Th. *Anthriscus cerefolium* ssp. *trichosperma* (*Alliarion*, 9: r), Cp-HH, *Baldingera arundinacea* (*Phragmition*, 13: +), Kt(eua)-H *Bromus inermis* (3: +), Eua(med)-H *Cichorium intybus* (15: +), *Eua*-TH *Echium vulgare* (*Fest-Brom., Chenopod.*, 9: +), Adv.-Th(TH) *Erigeron canadensis*, 9: +), Eua-H, *Gratiola officinalis* (*Agrostion-Magnocaricion*, 4: +).

Moose:

Brachythecium cf. *velutinum*		–	–	–	–	–	–	–	–	–	–	–	+–1	–	1–2	–	–	+–2	I
Catharinaea undulata		2–3	–	+	+	–	–	–	(+)	–	–	+	+	–	+	–	–	+–3	III
Dicranella heteromalla		1	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	I
Hylocomium proliferum		–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	+	I
Hypnum cupressiforme		2	––	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+–2	I
Polytrichum attenuatum		–	–	–	+	–	1	–	–	–	–	+	–	–	–	–	+	+–1	II
Syntrichia ruralis		–	–	–	+	+	–	+	+–2	–	+	–	–	–	1	–	+	+–2	III

Akzidentelle Moosarten: *Climacium dendroides* (6: +), *Entodon schreberi* ((1 : 2), *Polytrichum juniperinum* (2: +), *Rhodobryum roseum* (2: +) *Scleropodium purum* (14: 2), *Thuidium* ssp. (6: +–1).

Abb. 3

meratus, *J. effusus*, *Lysimachia*-Arten, *Mentha pulegium*, *Pulicaria*, usw.) vermischen. Den azidophilen Charakter der Assoziation zeigen die Arten *Aira c.*, *Hieracium bauhinii* und *H. pilosella*, *Jasione montana*, *Luzula campestris*, *Moenchia mantica*, *Rumex acetosella*, *Sieglingia decumbens* und *Veronica officinalis*, unter den Moosarten hingegen besonders *Syntrichia ruralis* an. Natürlich könnten ähnlich auch die basophilen Arten aufgezählt werden, sie werden aber beim Vergleich mit den kalkliebenden Rasen (*Festuco-Populo-Quercetum*) ohnehin erwähnt.

Der Grossteil der in der Tabelle angegebenen und hier aufgezählten azido-xerophilen Arten weist zahlreiche gemeinsame Züge mit der von MATUS-

KIEWICZ (1956) und MRÁZ (1958) beschriebenen westpolnischen und tschechischen *Potentillo-Quercetum cerris*-Assoziation auf. Ähnliches haben T. PÓCS aus der Őrség (1958), P. TALLÓS aus dem Széker-Wald (1959), I. SZODFRIDT — P. TALLÓS (1964) aus der Umgebung von Felsőnyirád unter dem Namen *Potentillo albae-Quercetum deschampsietosum* bzw. *Potentillo albae-Quercetum asphodeletosum* publiziert. Von den letzteren ist die erste mit der *Deschampsio-Quercetum robori-cerris*-, die zweite mit der *Asphodelo-Quercetum robori-cerris*-Assoziation identisch. Die von mir hier beschriebene *Agrostio-Quercetum robori-cerris*-Assoziation (früher *Quercetum robori-cerris arrabonicum* genannt) steht in enger floristischer und räumlicher Beziehung zu beiden. *Agrostio-Qu. r.-c.* steht nämlich im Praenoricum (von Vitnyéd bis zur Őrség) mit *Deschampsio-Qu. r. c.*, im Praeillyricum dagegen (südlich von Devecser) mit *Asphodelo-Qu. r.-c.* in Berühung. *Deschampsio-Qu. r.-c.* tritt aber nie auf »Cseri-Böden« mit verdichtetem Schotterhorizont auf, und im Gegensatz zu *Agrostio-Qu. r.-c.* sind ihre Trennarten *Castanea*, *Betula pubescens*, *Calluna vulgaris*, *Genista ovata* ssp. *nervata*, *Molinia litoralis*, *Festuca heterophylla*, *F. tenuifolia*, *Potentilla alba*, *Pulmonaria angustifolia*, *Serratula tinctoria* und *Valeriana officinalis*. *Asphodelo-Qu. r.-c.* wächst dagegen auf fruchtbareren braunen Waldböden und weist im Gegensatz zu *Agrostio-Qu. r.-c.* folgende Trennarten auf: *Asphodelus albus*, *Carex fritschii*, *Dianthus barbatus*, *Festuca heterophylla*, *Luzula forsteri*, *Lychnis coronaria*, *Potentilla alba*, *Tamus communis* und *Veratrum nigrum*.

Es ist bemerkenswert, dass *Agrostio-Quercetum r.-c.* ostwärts, im Zentrum des Arrabonicums in *Festuco-Populo-Quercetum arrabonicum* (*Festucetum vaginatae arrabonicum* Borhidi) übergeht. Von hier entstammen viele basoxerophile gemeinsame Arten, wie *Juniperus communis*, *Populus canescens*, *Gypsophila arenaria*, *Cerastium semidecandrum*, *Thymus s.*, *Th. glabrescens*, *Potentilla arenaria*, *Sanguisorba minor*, *Sedum acre*, *S. sexangulare*, *Dorycnium germanicum*, *Asperula cynanchica*, *Galium verum*, *Scabiosa ochroleuca*, *Euphorbia cyparissias*, *Teucrium chamaedrys*, *Carex liparicarpos*, usw.

Zusammenfassend: Die zönotaxonomische Stelle der *Agrostio-Quercetum robori-cerris*-Assoziation der Kleinen Ungarischen Tiefebene gehört innerhalb der *Quercetea pubescenti-petraeae*-Klasse und der *Quercetalia pubescentis*-Ordnung zu der *Quercetum petraeae-cerris* Hauptassoziation des *Quercion pubescenti-petraeae*-Verbandes (vergl. Soó 1971) und steht mit ihren verwandten Assoziationen in enger floristischer Verbindung. Die Assoziation ist durch auenartige Bestandstruktur, niedrige Baumhöhe und geringen Holtzertrag, starke Rasenbildung und Degradation, ferner durch die ständige Gegenwart des »Cseri-Bodens« mit seinem Wechselwasserhaushalt gekennzeichnet. P. MAGYAR verweist richtig darauf (1962), das die Benennung »Cseri« nicht die enge Verbindung mit der Zerreiche andeutet im Ungarischen heisst die Zerreiche »Csertölgy« sondern nach dem alten ungarischen Wortgebrauch

die ungünstige, schlechte Qualität einer Sache — in unserem Fall des Standorts — bedeutet.

Dessenungeachtet ist dies eine typische Assoziation unserer verödenden ungarischen Landschaften, und ihre Kenntnis vervollständigt das Bild, das R. Soó in seiner mehrere Jahrzehnte umfassenden Tätigkeit von der Pflanzendecke in Ungarn gezeichnet hat.

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HORMONAL CONTROL OF NUCLEASES IN PLANTS

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The seedling leaves of *Avena sativa* L. contain several nucleolytic enzymes. Four of these enzymes were isolated, purified, characterized and quantitatively assayed in control and hormone (kinetin, abscisic acid) treated leaves. It was shown that not all of the nucleases studied respond to hormone-treatment. Abscisic acid stimulated the formation in young leaves of a sugar non-specific nuclease which, under normal conditions, was shown to occur in young leaf tissues in small amounts only. The same nuclease was demonstrated to become a major nucleolytic enzyme of the Avena leaf during natural senescence of the leaf tissues.

Introduction

The rate of synthesis and/or breakdown of proteins and nucleic acids in plant tissues is under hormonal control. Because of their apparent importance in plant metabolism, nucleolytic enzymes have been investigated by a number of workers from this point of view. However, in all earlier work total nuclease activity was measured as a function of hormone-treatment (CHRISPEELS and VARNER, 1967; MCHALE and DOVE, 1969). Plant tissues are known to contain various nucleolytic enzymes with supposedly different functions. Therefore, the problem as to whether the effect of hormones on the nuclease level simply reflects the overall effect of hormones on proteins, or one or more nucleases are affected by the hormones more specifically, remained an open question. The present paper is a short summary of investigations carried out in this field by my co-workers (J. UDVARDY, N. V. WYEN, S. ERDEI, F. SOLYMOSY), prof. E. MARRÉ of the University of Milan, and myself during the past 5 years. We succeeded in showing that the effect of hormones (kinetin and abscisic acid) is quite specific on individual, well defined nucleases.

Material and methods

The study of hormone effects from the above point of view required a detailed analysis and characterization of the nucleases present in a well defined experimental system. The first seedling leaves of *Avena sativa* L. were chosen for this purpose. Investigations were carried out at various ages of the first leaves (8 to 30 days). The first leaves of *Avena* seedlings reach relatively rapidly the stage of senescence and the above mentioned period (8 to 30 days) includes both young (still developing) and fully grown out, senescing leaves.

The analytical techniques applied in the isolation, characterization and quantitative determination of the individual nucleases have been described in previous publications in detail (WYEN et al., 1969; 1971, 1972; UDVARDY et al., 1970). By the use of these techniques it was possible to detect in the *Avena* leaves five different nucleases, and analytical procedures were worked out to determine quantitatively the amount of four of these enzymes. The list of the enzymes isolated is presented and the properties of the nucleases are summarized in Table 1. It may be seen that three endo- and two exonucleases were found. One of the enzymes was specific for RNA as substrate. The others hydrolyzed both RNA and DNA. Of particular interest is the sugar non-specific endo-nuclease which has the same type of relative base specificity for RNA and DNA (WYEN, ERDEI and FARKAS, 1971). This enzyme was present only in traces in young leaves. During senescence, a massive accumulation of this enzyme was found. The sugar non-specific nuclease became a major enzyme of the ageing leaf. The accumulation of this nuclease appears to be a phenomenon quite specific for senescence, the amount of other nucleases being unchanged during ageing.

Since senescence in leaves is regulated by the hormon pair cytokinins/abscisic acid, the effect of kinetin, a synthetic cytokinin, and that of abscisic acid was tested on the level of individual nucleases in the *Avena* leaf.

Detached leaves of young *Avena* seedlings were floated on the surface of water (control) and on solutions of the plant growth regulators at various concentrations for various periods of time (2 to 48 h). In preliminary experiments crude extracts were prepared from the leaf tissues and analyzed for total RNase and DNase activities.

Results

The following observations were made:

(1) Leaf excision in itself (water control) leads to a significant and steady increase in overall (total) nuclease level.

(2) Increase in RNase activity is rapid in the excised leaf during the first 3 to 6 hours of incubation and then gradually levels off.

(3) No increase in DNase activity occurs after leaf excision for 6 to 8 hours. Later, a steady and dramatic increase in DNase level is experienced which continues for more than 48 hours, associated with the development of visible signs of senescence (yellowing).

(4) Kinetin, in a range of concentrations (0.02—1.0 mM), decreases the RNase level as compared to the water control.

(5) Treatment with abscisic acid (0.005 mM) leads to a marked increase in RNase activity early after leaf excision (2—6 h). Later the effect of abscisic acid on the RNase level becomes less (expressed on a percentage basis). On the other hand, 6 to 8 hours after leaf excision (and the commencement of treatment) abscisic acid starts to increase dramatically the DNase level. Simultaneously, abscisic acid stimulates the onset of senescence (yellowing) in the excised leaves.

Discussion

From the above results one can conclude that the effect of hormones on the level of plant nucleases, particularly that of abscisic acid, is complex. It depends, among others, on the timing and/or duration of treatment. Thus,

abscisic acid stimulates the increase in RNase activity in short-term experiments and affects the increase in DNase activity in long-term treatments.

On the basis of preliminary experiments, therefore, a more detailed analysis of the effect of hormones on plant nucleases appeared warranted.

It has been shown in our previous studies that at least four different nucleases can be assayed quantitatively in total protein extracts of *Avena* leaves. The procedure essentially consists of the extraction of total soluble proteins in slightly alkaline buffer, precipitation of the proteins by ammonium sulfate at 80% saturation and chromatography of the proteins on Sephadex G-75. Determination of enzyme activities in the fractions obtained makes a quantitative assay of the following nucleases possible: (a) alkaline phosphodiesterase, an exonuclease producing 5'-nucleotides from both DNA and RNA (UDVARDY et al., 1970), (b) a sugar non-specific endo-nuclease which produces 5'-nucleotides from both DNA and RNA and has a relative specificity for adenylic acid (WYEN, ERDEI and FARKAS, 1971), (c) an endo-ribonuclease producing nucleoside 2', 3'-phosphates which are slowly converted, if at all, into 3'-nucleotides (WYEN et al., 1969) and (d) an acid phosphodiesterase

Table 1

Properties of nucleolytic enzymes isolated from seedling leaves of Avena sativa L.

Enzyme	pH optimum	Substrate hydrolyzed	Preference for single or double stranded substrate	Breakwodn products	Base specificity
Relatively guanine specific endo-ribonuclease	5.5	RNA	None	Nucleoside 2',3'-cyclic phosphates	G > A > U > > C
Relatively adenine specific endo-nuclease	5.5	RNA > > DNA	Single > double	Nucleoside 5'-phosphates	A > G ≅ U > > C
Alkaline phosphodiesterase	9.3	DNA > > RNA	Single > double	Nucleoside 5' phosphates	None
Acid phosphodiesterase	5.5	NI[a]	NI	NI	NI

NI[a] Not investigated

the properties of which have not been investigated yet in a greater detail. The determination of the amount of a fifth enzyme, a minor chromatographic variant of the sugar non-specific nuclease is also possible, although a somewhat more complex procedure is necessary to this end (UDVARDY and FARKAS, 1972).

Conclusions

From a detailed quantitative analysis of the relative amounts of the individual nucleases in control (excised, water-treated) and experimental tissues (excised, hormone-treated) the following conclusions can be drawn:

(a) In excised control leaves, soon after leaf excision (3—6 h), the amount of the endo-ribonuclease increases, whereas the amount of other nucleases remains unchanged.

(b) In excised leaves incubated on water for longer periods (24—48 h) an increase in the amount of the sugar non-specific nuclease becomes predominant.

(c) Treatment with kinetin tends to reduce the above listed changes in nuclease levels.

(d) Short-term treatment with abscisic acid (3—6 h) results in the stimulation of increase in the amount of the endo-ribonuclease.

(e) Longer treatment (8—48 h) with abscisic acid leads to an increase in the formation of the sugar non-specific nuclease.

The following conclusion can be drawn from the above results. Plant hormones do not induce the formation of new nucleolytic enzymes, they regulate the rate of synthesis and/or breakdown of enzymes which are formed to a smaller or grater extent in their absence as well. This means that the hormones exert their regulatory effect at the translational rather than at the transcriptional level. The results also show that several factors are involved in the regulation of the level of various nucleases in plant leaves. The early events after leaf excision are mainly associated with cellular injury and "shock" phenomena. Later, the metabolic processes associated with or leading to senescence become predominant. Both groups of physiological processes are coupled with changes in nucleases and both groups of processes are affected by hormones. This explains why the effect of hormones is different to that extent depending on the time and duration of application. The results described direct the attention of plant physiologists once more to the fact that, in contrast to a number of animal hormones, plant hormones act as multi-target agents and this makes the elucidation of the mode of action of plant hormones a formidable task.

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THERMORESISTENZ DER KATALASE IN HEFEZELLEN

Von

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In earlier examinations the author staged experiments with fresh and dried yeast, attempting to infer the presence of microorganisms by the detection of the catalase enzym. Yeast was used as a model instead of other microorganisms in the sample to be examined from a hygienic point of view, for example in drinking water, refreshing juices, ice-cream mass, etc. For the continuation of examinations it became necessary to clarify to what extent temperature modifies the activity of catalase. It appeared that in aqueous suspension the catalase activity of yeast at 20 °C remains almost unchanged for about 3 hours. With the increase in temperature, activity decreases rapidly; at 60 °C it ceases to exist practically within minutes. This datum is in agreement with the temperature values related in general to enzyms, at which proteins coagulate (with the exception of thermoresistant microorganisms). At a permanent temperature of 45 °C the activity of aqueous yeast suspension decreases in a rapidly commencing then gradually decelerating course, but it can be detected even after 3 hours.

Bei hohen Temperaturen tritt eine Denaturierung der Eiweissstoffe ein. Mit ihr verlieren auch die Enzyme im Protoplasma ihre Wirksamkeit. Um so überraschender ist es, dass z. B. die *Symploca thermalis* auch in Thermalwasser von +93 °C vorhanden ist. Mit Sicherheit kann man aber behaupten, dass andere sog. Thermalalgen (*Phormidium laminosum*, *Calothrix calida* usw.) in Gewässern mit Temperaturen von 62 °bis 70 °C dauernd weiterleben (FEHÉR, 1954). Enzym-Präparate gehen bei solchen Temperaturen zugrunde. Es steht also fest, dass das Innenmilieu von Zellen, die sich hohen Temperaturen angepasst haben, die Enzymegarnitur des Stoffwechsels vor Destruktion schützt.

Zur Untersuchung dieser Probleme benötigt man vielerlei Versuchsdaten. Der vorliegende Artikel ist ein Teil einer derartigen enzymologischen Versuchs-Serie, die die Thermoresistenz der Katalasen berührt. Sie bietet somit auch zur Widerstandsfähigkeit der Protoplasmen brauchbare Daten.

Methodisches Fragen

Hefe (*Saccharomyces cerevisiae*), die bei niedriger Temperatur getrocknet wurde, erwies sich für Versuchszwecke als sehr geeignet (FRENYÓ–PÁDI 1972). Von der Trockensubstanz wurde 0,1 gr in 100 ml Wasser gleichmässig suspendiert. Die Suspensionen wurden in Versuchskolben mindestens 1/2 Stunde lang in Wasserbädern von unterschiedlichen Temperaturen gehalten. Sodann bestimmten wir die peroxydzersetzende Aktivität der Suspensionen nach unserer Spezial-Methode (FRENYÓ, 1962; FRENYÓ—SZENDRŐI, 1963; MIHÁLYFI, 1965). Nun wurden je 1,5 ml Suspension und eine Lösung von 1%-igem H_2O_2 zusammengerüttelt und das Volumen des freigewordenen O_2 in 30 sec und in 60 sec gemessen.

Ergebnisse und Besprechung

Vor allem wurde die Abnahme der Katalaseaktivität im Zusammenhang mit dem Anstieg der Temperatur von 40° auf 60° geprüft. Die Mittelwerte dieser Daten und die Abweichungen der einzelnen Messergebnisse sind der Taballe 1 zu entnehmen.

Die Tabelle zeigt, dass die Wirkung der Hefesuspension gegenüber der Kontrolle bei 20 °C schon bei 40° C sinkt. Die Aktivität hört bei 60 °C ganz auf, was übrigens unseren Kenntnissen über die Temperaturempfindlichkeit entspricht.

Die graduelle Abnahme zeigt die Abb. 1. auf sehr anschauliche Weise.

Tabelle 1

Abnahme der peroxydzersetzenden Aktivität getrockneter Hefe Einfluss unter dem Einfluss der Wärmebehandlung

C°	Volumen des freigesetzten O_2	
	während 30 sec; $\bar{X} \pm s$	während 60 sec; $\bar{X} \pm s$
Kontrolle		
20	295 ± 5 mm³	419 ± 8 mm³
40	211 ± 7 mm³	299 ± 9 mm³
45	121 ± 9 mm³	172 ± 11 mm³
50	31 ± 2 mm³	44 ± 3 mm³
55	18 ± 2 mm³	29 ± 2 mm³
60	0 mm³	0 mm³

Zeichenerklärung: $\bar{X}$ = Mittelwert: $\pm$ s = Standard-Abweichung

Es ist auch zu berücksichtigen wie lange die Temperaturbehandlung dauert, der die Hefesuspension unterzogen wird. Deshalb haben wir einen Versuch unternommen, bei dem die Zeitfaktoren in Betracht gezogen wurden.

Auch die Tabelle 2 zeigt gegenüber der Kontrolle ähnliche Werte wie beim ersten Versuch. Die Suspension liess sich also reproduzieren. Etwas grösser ist die Abweichung, wenn man die Werte bei 45 °C, also 121 ± 9 und 172 ± 11 mit den Daten der Tabelle 2 (144 ± 5 und 297 ± 10) vergleicht. Der Unterschied ist wahrscheinlich dadurch entstanden, dass bei den in der Tabelle 2 zusammengefassten Versuchen die Wirkung der Temperatur von 45 °C beim Beginn des Messens ziemlich genau 30 Minuten lang anhielt. Bei den Versuchen gemäss Tabelle 1 hingegen wurden die Messungen bei 45 °C erst nach einer längeren Pause durchgeführt. Diese Abweichung ändert aber nichts an der Feststellung, dass der Katalasewert der Hefesuspension mit der Zeit stufenweise abnimmt. Diesen Verlauf zeigt die Abb. 2.

Tabelle 2

Abnahme der peroxydzersetzenden Aktivität getrockneter Hefe bei 45° in Abhängigkeit von der Zeit

Zeit	Volumen des freigesetzten O_2	
	in 30 sec; $\bar{X} \pm s$	in 60 sec; $\bar{X} \pm s$
0'		
Kontrolle	303 ± 4 mm³	421 ± 9 mm³
30'	144 ± 5 mm³	297 ± 10 mm³
60'	83 ± 5 mm³	146 ± 10 mm³
90'	64 ± 4 mm³	96 ± 6 mm³
120'	46 ± 3 mm³	67 ± 5 mm³
150'	36 ± 3 mm³	46 ± 4 mm³
180'	28 ± 2 mm³	32 ± 3 mm³

Zeichenerklärung: $\bar{X}$ = Mittelwert; $\pm$ s = Standard-Abweichung

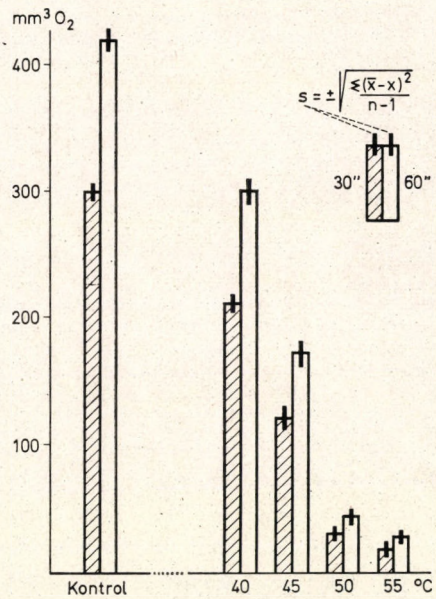

Abb. 1. Katalaseaktivität der bei verschiedenen Temperaturen aufbewahrten Hefesuspensionen, gemessen nach einer Spezialmethode am Volumen des in 30 sec und in 60 sec freigesetzten O_2

Das Diagramm verdeutlicht, wie stark die Katalaseaktivität anfangs abnimmt und dies besonders dann, wenn man das Volumen des frei gewordenen O_2 nicht in 30 sec., sondern in 60 sec misst. Im weiteren verzögert sich der Vorgang schon aus verhältnissmässig einfachen mathematischen Gründen.

Jedenfalls sinkt der Katalasewert der Suspension bei 45 °C in 180 Minuten auf sehr niedrige Werte; in 20 Stunden bricht die Aktivität praktisch gänzlich ab.

Es darf nicht übersehen werden, dass die Hefezellen in wässrigem Medium suspendiert sind, dass also auf die Kataloseenzyme nicht bloss die Temperatur von 45 °C wirkt, dass sich vielmehr einige Substanzen aus den Hefezellen herauslösen können. Das mag den Grund dafür bilden, dass wir

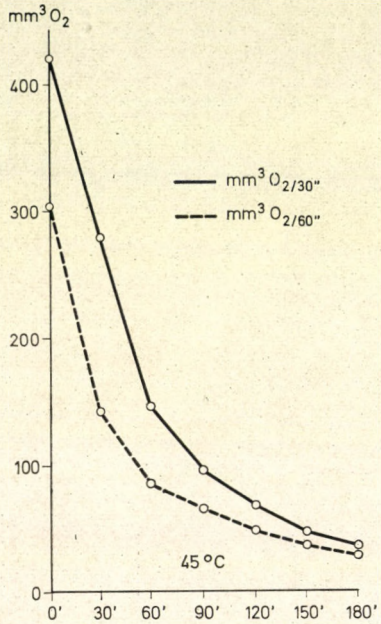

Abb. 2. Zeitabhängige Abnahme des Katalasewerten der Hefesuspension bei 45° C. Die Abnahme der Aktivität wurde zu den auf der Abszissenachse aufgetragenen Zeitpunkten gemessen

auch bei 40 °C eine Aktivitätsabstufung feststellten. Es wurde deshalb von uns untersucht, wie lange die Hefesuspension bei 20 °C den ursprünglichen Katalasewert bewahrt. Ohne auf Detaille einzugehen, erwähnen wir hier noch, dass die Aktivität der Suspension bei ähnlichen Verhältnissen durchschnittlich 3 Stunden lang unverändert bleibt um aber dann in 24 Stunden stufenweise auf etwa die Hälfte abzusinken. Nach diesem Zeitraum erhöhte sich zwar die Aktivität, doch stammte das nicht mehr von der Hefe, vielmehr war es ein Zeichen der Infizierung.

Zusammenfassung

Wir untersuchten die Katalaseaktivität allmählich getrockneter Hefe in Abhängigkeit von der Temperatur und der Zeit. Die Aktivität wässriger Suspensionen nahm schon bei 40 °C binnen einer Stunde ab; bei 60 °C verlor

sie ihre Aktivität ganz. Bei konstanter Temperatur von 45 °C nimmt der Katalasewert der Suspension rasch, dann aber stufenweise langsamer ab, um in 3 Stunden bloss 7 bis 9% des ursprünglichen Wertes zu erreichen. Bei Zimmertemperatur änderte sich die Wirksamkeit der Suspension auch in 3 Stunden nicht. Bei Beurteilung der Thermoresistenz brauchen also andere Faktoren als die Temperaturwerte kaum in Betracht gezogen zu werden.

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COMMENTS ON THE TIME DIRECTION OF BIOLOGICAL EVOLUTION

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Biological evolution has a time direction which is seemingly opposite to the time direction dictated by the second law of thermodynamics. In analyzing this question the time arrows of physics are shortly reviewed and the hypothesis is put forward, that spin polarization in the biological electron transport is associated with time arrow of biochemical processes. CPT theorem serves as a theoretical basis for this assumption. It is suggested to study the question experimentally by positron annihilation in crystalline form of L-amino acids and their D isomers.

In this paper I want to put forward a hypothesis concerning the biological evolution. I realize that a truly scientific paper would be of greater value, but I think that at this festal occasion we have to attack fundamental problems. Though the greater part of this paper is of speculative character, I hope it is done on a solid, widely accepted experimental and theoretical basis.

We could define the problem quite stricktly with the words of BRONOWSKI (1969): "How does it come about, that evolution as a whole appears to have a direction of time, namely the direction of greater complexity? If there is any single question to be answered about biology it is: why does biological time have this particular direction?" I share the scepticism regarding the assumption of the contemporary biology that the combination of the known laws of physics and chemistry with DARWIN's theory and the idea of chance mutations can satisfactorily explain evolution (HEISENBERG 1959, ULBRICHT 1962). Some mathematicians recently said that computer simulation of evolution shows the evolutionary theory to be inadequate and they complain, that biologists can not provide sufficient information for efficient computer simulation (MOORHEAD and KAPLAN 1967).

But, if chance, MENDELian inheritance and natural selection fail to explain evolution — though they undoubtedly played a very important role — we have to look for something else. Let us be bold enough to analyze the nature of time in connection with evolution. Can we really speak about the "direction of time" as BRONOWSKI did? Are there different directions of time? Do evolution and life have a special, "local time," the arrow of which points toward a particular direction different from other time arrows? About a decade ago it was absolutely impossible to start with a speculation like this.

But in the last few years our notion about time has been dramatically changed. The expressions "time inversion", "time reversal", "time moving forward and backward" are widely used in physics, and we, biologists must be aware of that if we want to get a deeper insight into the basic phenomena of life. Therefore, I will give here a very short review of the topic.

Time and relativity theory. Before EINSTEIN, time has been considered as absolutely independent either of space or movement. Special relativity deprived time of this independence; it predicted that a moving standard clock will record less time compared with co-ordinate clocks distributed at rest in an inertial reference space. This prediction has recently been tested (HAFELE and KEATING 1972). Four cesium beam clocks flown around the earth on a commercial jet flight, once eastward, and once westward. As was expected from theoretical predictions the flying clocks lost time (aged slower) during the eastward trip and gained time (aged faster) during the westward trip. Thus the "speed" of time is not constant in different co-ordinate systems. But does it have a special direction? The second law of thermodynamics gives information concerning this.

Time direction and thermodynamics. The second law of thermodynamics states that ordered systems tend to evolve in such a way as to increase their degree of disorder or randomness. The evolution toward increasing randomness defines the direction of time. This idea was put forward first by EDDINGTON in his GIFFORD lectures; he said: "It is possible to find a direction of time . . . Let us draw an arrow arbitrarily. If as we follow the arrow we find more and more of random elements in the state of the world then the arrow is pointing toward future; if the random element decreases, the arrow points toward the past" (GARDNER 1967). It has been shown that this gain in randomness (entropy) means loss of information.

Cosmological arrow of time. Everybody knows that the universe expands. It has been shown by an astrophysical school, that the origin of the second law of thermodynamics can be traced back to this most significant time arrow because the expansion of the universe becomes a huge "thermodynamic sink" for all the radiation flowing out into empty space. Resolution of this very compelling question is not my particular concern, I refer the interested reader to the basic expositions of the subject by GOLD and SCHUMACHER (1967), LANDSBERG (1970) and GAL-OR (1972). I rather turn to the question of what elementary particle physics says about time.

The space-time view of quantum electrodymanics and the time arrow. In the formulation of the nonrelativistic quantum electrodynamics the idea of time reversal played an important role. In FEYNMAN's words: "If an electron is moving back from the future, that is equivalent to changing the sign of the charge, and therefore it would act like a positron . . . positrons could be simply represented as electrons going from the future to the past" (FEYNMAN 1966).

That time direction is connected with matter and the reverse time direction with antimatter is a somewhat mysterious consequence of the so-called CPT theorem.

Time arrow and the CPT theorem. In this abbreviation C (Charge) stands for the interchange of matter into antimatter, P (Parity) for the interchange of left and right; T (Time) for the time reversal transformation, that is the interchange for past and future. The essential point of the CPT theorem is that the physical laws must be unchanged under the simultaneous transformation of matter into antimatter (C) right handedness into left handedness (P) and past into future (T); (For literature see: SACHS 1963). Before 1956 it was generally accepted that there is no intrinsic difference between left and right, positive and negative charge, thus nature was considered to be absolutely symmetrical in respect to these properties. Experiments, however, have shown that both C, P and the combined CP symmetry is violated which implies that nature does distinguish left from right and matter from antimatter is an absolute sense (WIGNER 1965; For literature see: ROSE and NILSON 1967). From the failure under C, P and CP transformation it follows that there must be a counterbalancing failure in T transformation. In other words, once we assume that CPT symmetry is conserved then the observation of CP violation implies that T violation must occur as well. Though T invariance has been checked experimentally and no violation has been found (OVERSETH 1969, SACHS, 1972) still there is reason enough to suppose an interlocking of charge, parity and time direction. It should be noted that a link with expansion of the universe and CP violation has been suggested (AHARONY and NE'EMAN 1970). Thus all the known time arrows are seemingly consistent in pointing to the same positive direction.

Time direction in biology. Let us now turn back to biology, to the time arrow of evolution. As it is known evolution has produced less and less likely states. In the sequence of generations the organization of species becomes more improbable and the informational system fuller. Chance and selection as mentioned before does not seem to provide a satisfactory explanation. Even the fact, that living beings are open systems and that they absorb energy from their environment would not prevent their entropy from increasing (BRONOWSKI 1959, ULBRICHT 1962). Thus the biological time arrow points into the opposite direction of that toward which the many consistent physical time arrows point.

How can we study this problem experimentally? Of course any direct approach seems to be out of reach. Living beings consist of matter and not of antimatter to which the time reversal seems to be linked. The CPT theorem, however, offers an indirect experimental approach, because it says that time direction is accompanied with angular momenta as well. As SACHS (1963) writes: "Since clockwise rotation becomes counterclockwise under time reversal,

the spin vector will be reversed in direction." But how can we know which spin direction is linked with positive time direction and which one with negative time direction? Probably β decay gives some information about this question. In β^- decay electrons are produced in a "left-handed" form; more precisely their spins are polarized opposite to their direction of motion. For the positron the opposite is true. Their spin direction in β^+ decay points toward their direction of motion. We do not have positrons in living systems, but we have electrons which drive life as they are transported in a chain of molecules. It has already been shown that these electrons are at least partly polarized (GARAY 1971). Let us check the direction of their polarization. If they are polarized in their direction of motion like positrons in β^+ decay, that may perhaps be an indication of a special biological time direction.

I suggest the following experiment. Let us study the annihilation of polarized positrons (β^+ particles) in L and D optical isomers of aromatic amino acids. I suppose that in some respect the middle of benzeene ring of L and D molecules can be considered as a space reflected environment for the annihilating positron. Because in L and D molecules two opposite spin direction is preferred (GARAY 1971) we may expect differences in positronium formation in the two isomers. More precisely the ratio of ortho/para positroniums will be different in L and D molecules. Furthermore, if spin vector is associated with time direction then the life time of positroniums will not be the same in L and D molecules respectively. Table I. may help in understanding the expected situation.

WIGNER (1957) uses the phrase: "Time inversion transforms matter into meta-matter . . .". Does meta-matter has something to do with life? In the present state of our ignorance we are unable to answer this question. Nevertheless, I hope that this paper will stimulate thoughts and experiments among scientists interested in a greater understanding of the fundamental forces underlying the evolution of life.

Table I

Charge, spin and time direction according to CPT theorem and different phenomena such as β decay, biological and chemical processes

Interaction type			Charge	Spin	Time
Weak	antimatter		e^+	* →	−t
interaction	matter		e^-	** ←	+t
Electromagnetic	matter	biochemical processes	e^-	? →	?
interaction		chemical processes	e^-	⇄	+t

* Indicates longitudinal polarization in the direction motion.
** Indicates longitudinal polarization in the opposite direction of motion.

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EXPERIMENTE ZUR STEIGERUNG DES FASERERTRAGES BEIM HANF (CANNABIS SATIVA L.)*

Von

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(Eingegangen am 1. Januar, 1973)

Experiments positively influencing fibre quantity in hemp were conducted for 10 years in collaboration with the School for Agricultural Sciences of Keszthely, in 1961—1964, and with the Institute for Experiments in Agriculture in the Southern Plain in 1964—1970. They show that of the macro- and microelement fertilisers, applied in some 50 combinations in the course of years, those containing potassium, manganese and magnesium proved to be most efficient. Final experiments were conducted with this substances and the results evaluated by mathematical statistics. It was found that significant differences emerged under the effect of magnesium, manganese and potassium + magnesium fertilizers, achieving an increase of 27—32% in fibre quantity. At the same time, increase of 15—17% also with potassium and potassium + manganese fertilizers was attained which is a substantial result for the national economy.

Der Hanf ist eine unserer wichtigsten Faserpflanzen. Die vielseitige industrielle Verwertung seiner Bastfasern, die noch offenen Fragen seiner Anatomie machen es erforderlich, uns mit der Beeinflussung des Hanffaserertrages eingehender zu befassen.

Dieses Referat ist der Schlussbericht einer elfjährigen Untersuchungsreihe, die wir in Zusammenarbeit mit dem Lehrstuhl für Botanik an der damaligen Landwirtschaftlichen Hochschule in Keszthely 1961—1964 und mit dem Landwirtschaftlichen Forschungsinstitut der Südlichen Tiefebene, Szeged 1964—1970 durchgeführt haben.

Das Ziel unserer Experimente war, den Faserertrag des Hanfes durch verschiedene Mineraldünger-Dosierungen zu beeinflussen. Aufgrund der Schrifttumsangaben verwendeten wir in erster Linie Kalidünger in der Form von Kalisulfat je 100 kg/Katastraljoch — 100 kg/0,57 ha. (4, 17). Später stellte sich heraus, dass zur Stimulierung auch eine wesentlich kleinere Dose genügt. In der ersten Untersuchungsreihe wurden die Fasern selbst gemessen, wobei durch Messung des Lumens bzw. der grösseren und der kleineren Faserdurchmesser im Durchschnitt von je hundert Fasern die Querschnittsfläche der Fasern bestimmt wurde. Gleichzeitig wurde auch die Faserlänge gemessen. Die Ergebnisse zeigten, dass durch die Verwendung von Kalidünger die Wand

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der Fasern um 11% verstärkt und die Fasern um 21% verlängert wurden (5).

Im nächsten Jahr wiederholten wir diese Experimente und wieder erhielten wir mit dem Kalidünger gute Ergebnisse, besonders dann, wenn wir gleichzeitig auch Phosphor- und Stickstoffdünger verwendeten (6). Bei den Faserverteilungsuntersuchungen fanden wir, dass sich für die vergleichenden Untersuchungen immer das dritte Stengelglied von unten am besten eignet, da von diesem aufwärts die Abmessungen und die Flächen der Fasern ständig abnehmen, so dass sie in den oberen, den 10—12. Internodien nur noch die Hälfte jener der 2. und 3. Internodien von unten erreichen (7).

Ab 1964 wurden in Zusammenarbeit mit dem inzwischen verstorbenen I. JAKOBEY nicht mehr die einzelnen Fasern, sondern die Faserbündel, ihre Querschnittsflächen mit einer Okularmessschraube gemessen, wobei die

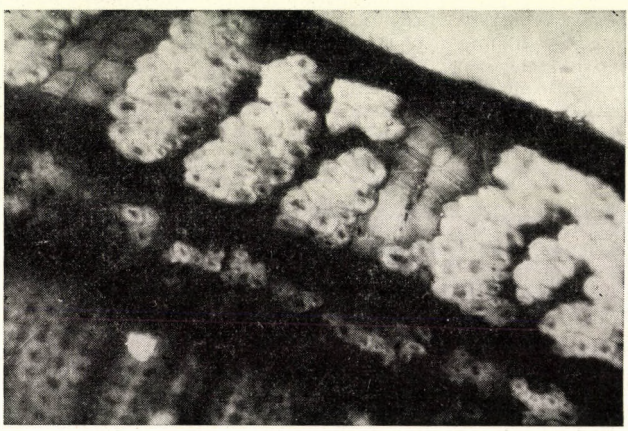

Abb. 1

Werte in Quadratmikron registriert wurden. Wir änderten auch die Behandlung in dem Sinne, dass wir schliesslich Kali- und Phosphordünger sowie magnesium-, mangan-, bor-, zink- und molybdänhaltige Düngemittel in 50 verschiedenen Variationen auf 2×2 m grossen Versuchsparzellen in randomisierten Blöcken und je viermal wiederholt benutzten; die Fläche eines Faserbündels wurde jeweils aus dem Durchschnitt von 200 mikroskopischen Messungen errechnet. Von jeder Parzelle untersuchten wir 20 Individuen, wobei wir an allen Individuen je 10 Messungen vornahmen. Aus diesen Untersuchungen ging hervor, dass Kalidünger sowie mangan- und magnesiummanchmal auch kupfer- und kobalthaltige Düngemittel den Faserertrag am wirksamsten erhöhten (8, 9). Das Photo zeigt die Anordnung der Bastfaserbündel im Querschnitt des Hanfstengels.

Tabelle 1. zeigt die in Form von Sulphatsalzen gereichten K-, Mn- und Mg-düngerbehandlungen zusammen mit den unbehandelten Kontrollen in 8 Kombinationen der sog. monofaktoriellen Experimenten.

Tabelle 1

Monofaktorielle Experimente in 8 Kombinationen

Kombinationen	Behandlungen mit			Bezeichnungen	
	K	Mn	Mg		
1	0	0	0	(1)	Kontrolle
2	1	0	0	K	Kalidünger
3	0	1	0	Mn	Mn-dünger
4	0	0	1	Mg	Mg-dünger
5	1	1	0	K Mn	K-Mn-dünger
6	1	0	1	K Mg	K-Mg-dünger
7	0	1	1	Mn Mg	Mn-Mg-dünger
8	1	1	1	K Mn Mg	K-Mn-Mg

Tabelle 2. zeigt die zufälligen Blockanordnungen zusammen mit den in Quadratmikron angegebenen Durchschnittswerten der Faserbündel.

Tabelle 2

Zufällige Blockanordnungen

Wiederholungen	Kombinationen							
1.	2	6	5	(1)	8	4	7	3
	6315	7193	7139	4699	4216	7735	5882	6898
2.	(1)	8	7	4	5	2	3	6
	4687	4804	4795	5481	4608	5807	6422	5318
3.	6	(1)	2	8	3	5	7	4
	4927	4333	4286	5140	5194	5469	4060	5220
4.	(1)	4	5	8	6	3	7	2
	4776	6072	4343	4708	6108	4954	4694	4901

Tabelle 3. zeigt die Zusammenstellung der Kombinationen und ihre Durchschnittswerte.

Tabelle 3

In Kombinationen

Kombinationen	Wiederholungen				Zusammen	Im Durchschnitt
	1	2	3	4		
(1) Kontrolle	4 699	4 687	4 333	4 776	18 495	4 624
2. K	6 315	5 807	4 286	4 901	21 309	5 327
3. Mn	6 869	6 422	5 194	4 954	23 468	5 867
4. Mg	7 735	5 481	5 220	6 072	24 508	6 127
5. K Mn	7 139	4 608	5 469	4 343	21 561	5 390
6. K Mg	7 193	5 318	4 927	6 108	23 546	5 889
7. Mn Mg	5 882	4 795	4 060	4 694	19 431	4 858
8. K Mn Mg	4 216	4 804	5 140	4 708	18 868	4 717
Zusammen	50 077	41 922	38 629	40 558	171 186	

Danach errechneten wir die gesamten SQ-, die wiederholten SQ-, die behandelten SQ-, und die MQ-Werte, woraus wir unter Berücksichtigung des Wertes SD 5% = 1075,52 die signifikante Differenz errechneten (16—20). Tabelle 4. zeigt diese Werte.

Tabelle 4

Ergebnistabelle

Behandlungen	Flächenraum des Bündelquerschnittes in Quadratmikron (Durchschnittswerte)
4. Mg	6 127
6. K Mg	5 889
3 Mn	5 867
5. K Mn	5 390
2. K	5 327
7. Mn Mg	4 858
8. K Mn Mg	4 717
(1) Kontrolle	4 624
SD 5%	1 075,52

Aufgrund dieser Tabelle kann festgestellt werden, dass eine signifikante Differenz zwischen den Pflanzen auf den Parzellen 1 (unbehandelte Kontrolle) und 4 (mit magnesiumhaltigem Dünger behandelt), ferner zwischen den Parzellen 1 und 3 (mit manganhaltigem Düngemittel behandelt) und den Parzellen 1 und 6 (mit Kali- und Magnesiumdünger) besteht, dass jedoch

der signifikanten Differenz auch die Pflanzen der Parzelle 5 (Kali- und Mangandünger) und 2 (nur mit Kalidünger behandelt) nahe stehen.

Prozentual erhöht sich die Fasermenge im Hanfstengel infolge der Behandlung mit Kali-Magnesiumdünger sowie mit magnesium- und manganhaltigen Düngemitteln um 27—32%, während sich durch Behandlung mit Kali- und Kali-Mangandünger nur eine Annäherung an die signifikante Differenz erreichen lässt. Immerhin bedeutet aber auch dies eine 15- bis 17-prozentige Steigerung des Faserertrages, volkswirtschaftlich gesehen, ist dies ein bedeutsames Ergebnis.

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ZUR ÖKOLOGISCHEN CHARAKTERISIERUNG VON MITTELGEBIRGEN UND IHREN MONTANEN WALDGESELLSCHAFTEN NACH KLIMAFAKTOREN. II.

von

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(Eingegangen am 16. April, 1973)

Die Klimaverhältnisse in der montanen Stufe der natürlichen Buchen- (Tannen-) Wälder (ggf. mit Edellaubhölzern)

Je weiter man aus der Zone der windausgesetzten Hochlagen und Gipfel, der klimanivellierenden Niederschläge und häufigen Nebel nach unten in niedere Lagen herabsteigt, umso gegensätzlicher wird das Klima, umso mehr differenzierte es sich nach dem Relief und der Exposition, umso stärkere Unterschiede ergeben sich aus der — auch klimatisch bedingten — Bodenentwicklung auf den vielseitigeren geologischen Substraten, umso mehr unterscheiden sich die Gebirge in gleichen Höhenlagen, und umso vielfältiger wird das Mosaik der Waldgesellschaften auf diesen unterschiedlichen Standorten.

Grob gesagt, ändert sich der Klimacharakter vom Gebirgsatlantisch Borealen der höheren Lagen zum Subatlantischen bis — in besonderen Lagen — Subkontinentalen, bleibt aber innerhalb der deutschen Mittelgebirge im Bereich des »Übergangsklimas« im Sinne RUBNERS (1953).

Die Buchenwaldstufe schliesst sich nach unten an die obermontane Verzahnungszone der Fichten/Buchen-Hochlagenmischwälder an und bildet in der submontanen Stufe ihrerseits einen Verzahnungsgürtel mit den Baumarten des Eichenmischwaldes (*Carpinion* bzw. *Quercion roboris-petraeae*). Angaben über die Höhenlage dieser Stufe können nur einen groben Anhalt bieten, da nicht selten aufgrund der oben beschriebenen kleinklimatischen, stark differenzierenden Wirkungen des Reliefs eine beachtliche Spanne besteht und z. B. in kühlen Tälern Buchenwaldgesellschaften ggf. *Acer pseudoplatanus*, *Fraxinus excelsior* zu finden sind, während in der horizontal oft sehr ausgedehnten warmen Hangzone darüber noch eine Eichenmischwald oder an sonnseitigen Hängen ein *Melico-Fagetum* herrscht.

Als Anhalt für die Höhenverbreitung der Buchen-Tannenwälder und reinen Buchenwälder dieser Stufe können folgende Angaben dienen: *Dentario enneaphyllidis- (Abieti-) Fagetum* des SO-Raumes: Sudeten (400) 500—1000 m, Erzgebirge (450) 500—750 m, Thüringisches Schiefergebirge (gegen W ausklingend) 500—760 m, Frankenwald 450—620 m, Bayerischer Wald und Grenzgebirge 730—1140 m, nach Sonn- oder Schatthanglage wie bei den nachstehenden differenziert.

Subatlantischer artenreicher Tannen-Buchenwald (*Abieti*-Fageten Obdf. 1957) des SW-raumes, des Schwarzwaldes, der Vogesen und der montanen *Lathyro verni*-Fageten auf

Jura (Schwab. Alb, Schweizer und Französischer Jura) von 500 m aufwärts bis über 1000 m bzw. bis zur unteren Waldgrenze (einschl. montane submediterran beeinflusste *Dentario heptaphylla-* und *digitata*-Fageten.

Nördlich der Tannengrenze längs der nördlichen Mittelgebirgsschwelle treten als vikariierende Buchenwaldgesellschaften auf: *Dentario bulbiferea-Fagetea* in Höhenlagen zwischen 500— (bis 700 > 700) 800 m ü. NN. (Rhön (930 m), Vogelsberg (770 m) auf Basalt mit und ohne Lössauflagen, im Harz (bis 650 m) und im Rheinischen Schiefergebirge (bis 700 m) nur auf nährstoffreicheren Devonschiefern, — grauwacken bzw. Urkalken. Im übrigen werden sie oft grossflächig von *Luzulo*-Fageten bis zur Buchenwaldgrenze bis maximal 840 m (Kahler Asten im Rothaargebirge) abgelöst.

Die submontane Übergangszone zwischen Buchen- und Eichenmischwald, die nach unten die Stufe der natürlichen Buchenwälder ablöst, beginnt in den Ost- und Mittelsudeten etwa um 600 m über NN, in den Westsudeten, im Fichtelgebirge, im Bayerischen Wald und im Schwarzwald in Seehöhen um 500, ebenso im Odenwald und im Hessischen Berglande. Im Harz und im Rheinischen Schiefergebirge kann man etwa 400—450 m als untere Buchenwaldgrenze angeben.

Eine allgemeine Klimacharakterisierung der montanen Standorte der natürlichen Buchen- und Buchen-Tannenwaldstufe südlich der Verbreitungsgrenze der Tanne gibt folgendes Bild:

Die Jahresmitteltemperatur, die in der Fichtenwaldstufe 5—5,5 höchstens 6 °C nicht überschritt und an der Grenze zur subalpinen Stufe unter 3 °C herabsank, sinkt in der Buchenwaldstufe nur in der obermontanen Region unter 6 °C und erreicht normalerweise Werte von 7,5 °C und mehr. Die Temperatur der zeitlich festen Vegetationszeit (1. V.—30. IX.) liegt etwa zwischen 12 und 14,2 °C, die Temperatur der drei kältesten Wintermonate zwischen —3 und 0 °C. Die Jahresschwankung ist je nach der ± subatlantischen (s. Abb. 2, 5) oder subkontinentalen (s. Abb. 4) Klimatönung des betreffenden Gebirges sehr verschieden, die Werte schwanken innerhalb der montanen Buchen-(Tannen-)Waldstufe zwischen 15,4 °C im Sauerland und 20 °C im Altvatergebirge. Die Zahl der Tage einer Temperatur von 10 °C liegt etwa zwischen 100 und 160 Tage, die Unterschiede erscheinen wegen der häufigen Temperaturumkehr und der grösseren Ozeanität der höhen Lagen gegenüber der natürlichen Fichtenwaldstufe gering, doch lassen die weniger vorhandenen und nicht übertragbaren Daten ein sicheres Urteil nicht zu.

Die Niederschläge sind in der Regel geringer als in der hochmontanen Stufe der natürlichen Fichtenwälder, sie nehmen — beim Vergleich von Standorten gleicher Höhenlage — von Osten nach Westen r.h. in den westl. Gebirgen zu. In den östlichen Gebirgen, in Leegebieten, an der Grenze zur submontanen Stufe beträgt der Jahresniederschlag selten weniger, meistens mehr als 700 mm, um in höheren Lagen bis auf 1300 mm (Altvater) und 1800 mm und mehr (Schwarzwald) zu steigen. Entsprechend schwankt der in der Vegetationszeit vom 1. V. bis 30. IX. verfügbare Niederschlag zwischen 350 bis 500 mm. Die Luftfeuchtigkeit ist in der natürlichen Buchenwaldstufe im allgemeinen noch

hoch, der sie kennzeichnende »Trockenheitsindex« liegt fast immer über 60 und erreicht maximal Werte von 180 (Schwarzwald).

Entsprechend der stärkeren klimatischen Gliederung innerhalb der Gebirgsstufe der natürlichen Buchenwälder, die standörtlich durch den verschiedenartigen geologischen Aufbau der Mittelgebirge noch unterstrichen wird, zeigen verwandte Waldgesellschaften charakteristische pflanzengeographische Unterschiede, die gegenüber den Fichtenwäldern zu einer stärkeren Ausscheidung von Assoziationsgruppen führten (vergl. Reihe Ökologie der Wälder Bd. 1 p. 17).

Die Ost- und Mittelsudeten (z. B. Altvater, Reichensteiner Gebirge, Glatzer Schneeberg) zeigen in allen Klimaelementen den stärksten kontinentalen Einschlag. Bei Durchschnittstemperaturen der Vegetationszeit, die nur etwa um 0,5 °C geringer sind als im Schwarzwald, sinken die Durchschnitts-Wintertemperaturen (XII, I, II) nicht selten unter —3 °C, auch —4 °C, was eine in diesen Höhenlagen verhältnismässig grosse Jahresschwankung der Lufttemperatur bis zu 20 °C zur Folge hat. Auch die hygrische Kontinentalität deutet sich an in verhältnissmässig geringen Niederschlägen, deren Jahressumme etwa von 600—700 mm bis maximal 1300 mm schwankt, in hohem Anteil an Sommerregen (über 50%) und geringer Luftfeuchtigkeit (Trockenheitsindex 50 in der submontanen bis 100 in der obermontanen Stufe).

Der floristische Reichtum der Ost- und Mittelsudeten hat drei Ursachen: a) klimatische, nach dem atlantischen Westen zu wird erfahrungsgemäss die Pflanzenwelt artenärmer, b) geologisch-edaphische, das reiche Grundgestein und die geringere Auswaschung der Böden im weniger feuchten Klima, c) einwanderungsgeschichtliche, die östlichen Arten haben i.a. einen kurzen Wanderweg.

Die ostherzynischen Gebirge (Westsudeten mit Riesen- und Isergebirge, sächsich-böhmischen Randgebirge, mit Erzgebirge und Vogtland), sind nach Nordwesten zu dem Zustrom atlantischer Luftströmungen stärker ausgesetzt als die Ostsudeten, tragen innerhalb ihrer natürlichen Buchen-Tannenwaldstufe bereits gemässigteren Klimacharakter, der ausgeprägt ist in einer zwar geringen, aber im Zusammenwirken aller Elemente doch deutlichen und wirksamen Wandlung in Richtung zum Subatlantischen.

Geringere Winterkälte meist über —3 °C, geringere Jahresschwankung der Lufttemperatur (maximal 19 °C), höhere Niederschläge (bis 1500 mm) und ein höherer Trockenheitsindex (mindestens 60, höchstens 160) verdeutlichen dies.

Für die weniger markant aufragenden Bergzüge der westherzynischen Gebirge (Fichtelgebirge, Frankenwald, Thür. Wald) ist aufgrund ihrer nordwest—südöstlichen Streichrichtung die Luv — Lee-Wirkung klimatisch entscheidend. Im Temperaturklima stehen sie zwischen ostherzynischen Gebirgen und Bayerischen Walde, die Jahresschwankung ist besonders auf den subkontinentalen Leeseiten noch hoch (bis 18,5 °C), ganz besonders auch im Regenschatten des Fichtelgebirges um Weisenstadt (19,3°),Fichtelberg (19,2°) und Selb (19,2°). Die Unterschiede zwischen Luv und Lee prägen sich in den Jahresniederschlägen sehr deutlich aus, die Luvseiten (z. B. Warmensteinach/Fichtelgebirge, 628 m ü.NN,) und auch die Hochlagen erhalten bis zu über 1100 m Niederschlag, während dieser auf den Leeseiten, z. B. im Selber Kessel im Regenschatten des Fichtelgebirges, auf 700 und teilweise in niederen Lagen auf 650 mm herabsinkt, wobei gleichzeitig der Anteil an Sommerregen steigt (auf 50% und mehr), der Trockenheitsindex, der auf der Luvseite 100 erreichen kann und im Durchschnitt bei 60—80 liegt, sinkt hier auf 40—50. Hierdurch ist ein deutliches Bild von der grösseren Kontinentalität gegeben. Die Pflanzenwelt reagiert sehr deutlich auf diese klimatischen Unterschiede.[1]

Der Bayerische Wald (vergl. Querschnitt Abb. 4) mit seinen Erhebungen bis zu 1458 m (Gr. Arber), seinen Urgesteinsböden und seinem eigenen Gebirgsklima übt einen charakteristischen Einfluss auf die floristische Zusammensetzung seiner Pflanzenwelt aus, die zur Ausscheidung einer besonderen Assoziationsgruppe innerhalb der Buchenwälder Anlass gibt.

[1] So haben sich z. B. bei Selb noch Reste des Schneeheide-Kiefernwaldes erhalten liegt dagegen in seinem Süd- und Südwestteil im Einflussbereich submediterraner Luftströmungen, die den Südschwarzwald durch die Burgundische Pforte treffen, in seinem West- und Nordwestteil atlantischen Luftströmungen.

Ähnlich wie bei den westherzynischen Gebirgen, deren Streichrichtung er fortsetzt, aber gesteigert durch die grösseren Erhebungen, wirken sich Luv und Lee hier aus, in der Wirkung verstärkt durch den häufigen Einfluss kontinentaler Luftmassen. So ist es verständlich, wenn der Bayerische Wald klimatisch gewisse Anklänge an die Ostsudeten zeigt, z. B. in der Jahresschwankung der Lufttemperatur, die auch in grösseren Höhenlagen selten unter 18 °C sinkt und in 800 m über NN noch um 19 °C beträgt, doch sind sowohl die Vegetationszeit als auch der Winter etwas wärmer als in den Ostsudeten, die Schwankung verschiebt sich auf der Temderaturskala etwa um 0,5—0,8 °C nach oben. Auch zeigen die Jahresniederschläge auf der Luvseite höhere Maximalbeträge (bis etwa 1550 mm in der Buchenwaldstufe), und auch der Trockenheitsindex erreicht höhere Werte (70—120) als in den Ostsudeten.

Pflanzengeographisch ist der Bayerische Wald vor allem durch das Vorkommen hochmontaner Arten als *Soldanella montana* (Berg—Troddelblume) und durch das seltenere Vorkommen subatlantischer Arten wie z. B. (*Festuca altissima*, *Luzula albeda*) gekennzeichnet. Die letztere Art ist in den Sudeten ebenfalls selten, womit dokumentiert wird, dass der Bayerische Wald klimatisch noch zu den östlichen Gebirgen zu rechnen ist. Auch das regelmässige Vorkommen von *Dentaria enneaphyllos* im Zahnwurz-Buchenwalde kennzeichnet diesen als östlich-südöstlich vikariierende Gesellschaft.

Der Schwarzwald, als südwestlichstes Gebirge Deutschlands (vergl. Querschnitt Abb. 5.) liegt dagegen ausgeprochen im Einflussbereich westlicher Luftströmungen, die den Südschwarzwald durch die Burgundische Pforte und über die Vogesen, den Nordschwarzwald auch über die niedrigere Haardt erreichen. Über die Alpen kommende Föhnwinde beeinflussen den Südschwarzwald besonders im Frühjahr nicht selten. Die nord — südliche Streichrichtung macht sich in starken Luv — Lee-Effekten bemerkbar, die auf kurze Entfernung (z. B. Rheingraben-, Hochschwarzwald-Baar — vergl. Querschnitt 5) zu Klimaabwandlungen führen, wie sie in der Ebene sich in Entfernungen von Tausenden von Kilometern abspielen würden.

Der verschiedene geologische Aufbau und die damit verbundene Reliefgestaltung — Nordschwarzwald Gneis und Granit mit reicherer Gliederung — sind weitere Faktoren, die Klima und Pflanzenwelt mitgestalten.

Das Temperaturklima der Buchen-Tannen-waldstufe im Schwarzwald ist weniger durch warme Sommer als durch milde Winter gekennzeichnet. Die Vegetationszeit-Durchschnittstemperatur ist in gleichen Höhenlagen nicht höher als in den anderen bisher besprochenen Mittelgebirgen, der Winter (Durchschnitt Dez. bis Febr.) dagegen um mindestens 1—2 °C milder und entsprechend der Jahresschwankung der Lufttemperatur geringer. Sie sinkt in grösseren Höhen (um 900 m) an der atlantischen Luvseite teilweise unter 16 °C. Die Luv- und die Hochlagen empfangen hohe Jahresniederschläge bis zu 1800 mm, der Nordschwarzwald, da er nicht wie der Südschwarzwald im Regenschatten der Vogesen liegt, bis zu 2000 mm. Auch im Ostschwarzwald auf der Leeseite sinkt der Jahresniederschlag innerhalb der Buchenstufe mit einigen Ausnahmen (Baar) kaum unter 900 mm. Die Luftfeuchtigkeit ist hoch, der Trockenheitsindex schwankt zwischen 80 und 150 und zeigt Maximalwerte von 180.

Dieses günstige, subatlantische Klima, verbunden mit mittlerem Nährstoffreichtum der Böden, führt besonders im Schwarzwald zu höchster Ertragsleistung von Tanne, Buche und Fichte (letztere als natürliche Mischholzart oder künstlich eingebracht). Die Vegetation der Buchenwälder im Schwarzwald erreicht dagegen nicht den Artenreichtum der östlichen Assoziationen. Atlantische Arten wie *Teucrium scoradonia*, *Digitalis purpurea* und *Ilex aquifolium* (im Westschwarzwald) sind Weiser dieses atlantischen Klimaeinflusses. Auf der kontinentalen Baar-Hochfläche im Ostschwarzwald bilden sich vikariierende Assoziationen von Fichte, Kiefer, Tanne (ohne oder mit Konkurrenzschwacher Buche) aus. Im Nordschwarzwald finden sich infolge des basenärmeren Grundgesteins und der verbreiteten, klimatisch ungünstigen Plateaulagen weniger reiche und weniger hochhinaufgehende Buchenwaldgesellschaften. *Bazzanio*-Piceeten (ohne *Calamagrostis villosa*) treten vielfach an ihre Stelle.

Den nordwestdeutschen Mittelgebirgen — Harz, Hessischem und Leine Weser—Bergland, Rheinischem Schiefergebirge u. s. w. — fehlt von Natur aus die Tanne.

Dengler (1944) gibt als Ursache für die Nordgrenze der Tanne im Westen die Trockengebiete des Rhein — Maintales mit unter 600 mm Niederschlag an, im Osten wird als Ursache der Verbreitungsgrenze Winterkälte und Kontinentalität angesehen. Für das Fehlen der Tanne in den nordwestlichen, tannen-

freien Gebirgen von der Rhön ab lassen sich nach FIRBAS (1949) keine einwanderungsgeschichtlichen Gründe anführen, es müssen standörtliche vorliegen.

Die in Zahlen zu fassenden klimatischen Unterschiede gegenüber den Gebirgen mit Tanne sind aus Abb. 1. und Tab. 1. zu entnehmen, wirken aber alle in einer Richtung. Das Klima wird in diesen Gebirgen in hohem Masse durch das Vorherrschen atlantischer Luftkörper bestimmt und erhält aus diesem Umstand seinen feucht-kühlen ausgeglichenen Charakter. Die Niederschläge sind hier höher, die Jahresschwankung der Lufttemperatur und die Sommerwärme sind geringer als in gleichen Höhenlagen anderer deutscher Mittelgebirge, die die Tanne von Natur aus beherbergen, und — als wichtigstes Charakteristikum für die tannenfreien Gebirge — die Winter sind milde und besonders schneearm.

Da vor allem Harz, Rechtsrheinisches Schiefergebirge (Sauerland) und Eifel die ersten aus der Ebene aufragenden Erhebungen bilden, die die feuchten Luftmassen zum Aufsteigen zwingen, und der Harz zudem eine nordwest — südostliche Streichrichtung hat, so sind hier Luv- und Leelagen ganz entschieden ausgeprägt, wie aus den Querschnitten 2, 5 deutlich zu ersehen ist, doch wirkt sich dies in tieferen Lagen unterhalb der Zone der natürlichen Buchenwälder stärker aus.

Im Harz als höchster Erhebung des norswetdeutschen Berglandes liegt die Durchschnittstemperatur der festen Vegetationszeit in gleichen Höhenlagen mindestens 1 °C unter der Mittelgebirge mit Tanne. Die entsprechenden Temperatursummen $> 8°$ ergeben sich aus Querschnitt I. p. 117, 118 . . . und Tab. 1. und liegen mit 750—800—830 °C relativ niedrig; verglichen mit Rhön und den wesentlich wärmeren und (Schwarzwald) auch betont feuchteren süddeutschen Gebirgen. Die Stationen Hahnenklee und Clausthal-Zellerfeld mit 560 m SH weisen bei einer Andauer von > 8 °C von 160 Tagen 750—750 °C als Wärmesumme. Die Wintertemperaturen sind dagegen verhältnissmässig milde und die Jahresschwankung der Lufttemperatur daher gering. Sie beträgt um 15 bis höchstens 17 °C Die Niederschläge haben nicht die Höhe der Jahressummen im Schwarzwald, erreichen aber mit Ausnahme ausgesprochener Regenschattenlagen z. B. im Ostharz (Harzgerode 401 m über NN, 616 mm im Jahr) — im allgemeinen 800 mm oder liegen darüber und überschreiten nicht selten die 1000 m Grenze. In tiefen, den feuchten Regenwinden offenen Harztälern, so z. B. in Schluft im Siebertal, werden bis zu 1550 mm Jahresniederschlag gemessen, und sowohl in Schluft als auch in Sieber, St. Andreasberg, Oderhaus weist ein Wintermaximum des Niederschlags auf die hygrische Ozeanität des Westharzes hin.

Der »Trockenheitsindex« erreicht wegen des kühleren Klimas die Werte des Schwarzwaldes (bis 18°) —.

Obwohl der Harz besonders an seiner Luvseite bereits einen deutlich ausgeprägten kühlsubatlantischen Klimacharakter trägt, macht sich gegen Westen in dem Ansteigen der Wintertemperatur, dem Geringerwerden der Jahresschwankung und der Erhöhung der Niederschläge ein zunehmender atlantischer Einschlag beim Fortschreiten über das Westfälische Bergland zur Eifel und weiter zum Hohen Venn bemerkbar.

Wenige Zahlen mögen dies verdeutlichen: Innerhalb der Buchenwaldstufe in 600 m über NN sind die Vegetationszeittemperaturen 1. V.—30. IX. im Harz, Hochsauerland und Schneifel etwa gleich (um 12—12,5 °C), die Wintertemperatur dagegen im Harz um 1 °C geringer (XII—II im Durchschnitt —1,8 °C) Die Jahresschwankung liegt im Harz bei 16,5 °C, in der Schneifel mit Hohem Venn bei 14,8 °C.

Luv- und Leelage wirken sich besonders im Harz und in der Eifel aus. So erhält z. B. die an Seehöhe die Schneifel überragende Hohe Eifel geringere Niederschläge als jene, da sie in ihrem Regenschatten liegt.

Das Hessische und das Leine-Weserbergland nehmen klimatisch eine Mittelstellung zwischen dem Harz, den westherzynischen Gebirgen (Frankenwald, Thür. Wald) und dem Rheinischen Schiefergebirge ein. Die Jahresschwankung liegt hier in der Buchenwaldstufe zwischen 16 und 17 °C. Die höheren Lagen etwa über 600 m erhalten Niederschläge von 900 bis 1000 mm im Jahr. Die Hohe Rhön weist in 900 m über niedrige Wintertemperaturen auf, die auf einen gewissen östlichen Einschlag bzw. eine Verwandtschaft zum Klima des Thür. Waldes hinweisen könnten (Wasserkuppe 925 m über NN —2,9 °C, Wang/Riesengebirge 874 m über —3,1 °C, Kniebis/Schwarzwald 910 m über NN/—1,3 °C).

Zusammenfassend wäre über das Klima der Buchen-(Tannen-)Waldstufe zu sagen: Ihr Wärmehaushalt ist günstiger als der in der Fichtenwaldstufe durch höhere Jahres- und Vegetationszeit Temperaturen und gleichzeitig geringere Niederschläge. Die Schwankungen sind allerdings grösser, und mehr als im natürlichen Fichtenwald wird das Grossklima durch das Relief abgewandelt. Abschwächende »ozeanische« Elemente wie starker Nebel und Wolkendecke sind hier nicht mehr so wirksam. So können z. B. extreme Reliefverhältnisse wie Frostlöcher, steile Südlagen, Regenseite und Regenschatten sich in der Zusammensetzung der Pflanzendecke ausdrücken und zu eigenen Ausbildungen und Unterausbildungen führen.

Die allgemeine Klimacharakter bleibt trotz der gegenüber dem Fichtenwaldklima günstigeren Bedingungen kühl, feucht bis frisch.

Schlusswort

Die Klimaxgesellschaften der Mittelgebirge wie auch der Alpen und Karpaten sind in erster Linie klimazonal nach Höhenstufen und zugehörigen Klimadaten zu kennzeichnen. Waldstufen und Waldgesellschaften zeigen eine deutliche Abhängigkeit von den Klimabedingungen ihrer Standorte und von deren Boden- und Wasserhaushalt. Inwieweit Waldgesellschaften innerhalb von Klimahöhenstufen und ihre Böden nach ihrer Entwicklung auf entsprechenden Substraten von der Summe der auf sie wirkenden Klimafaktoren gestaltet werden, wurde in mehreren Arbeiten des Verfassers und Mitarbeiter in Zusammenarbeit mit dem Deutschen Wetterdienst zu klären versucht. Nach vegetationskundlicher Voruntersuchung der Waldgesellschaften in verschiedenen deutschen Mittelgebirgen auf einer Nord-Süd-Achse und mehreren West-Ost-Achsen wurden alle erreichbaren Klimadaten von charakteristischen Klimastationen und zusätzlich eingerichteten Beobachtungs-Stationen errechnet und für die klimaökologische Seite von Waldgesellschaften in verschiedenen Höhenstufen ausgewertet. Dabei wird auf die Darstellung der Verfahren der Verfasser HARTMANN, F. K. und SCHNELLE, F. et al.,

a.a.O. 1970 verwiesen. Insbesondere wurden zur Charakterisierung des Wärmehaushaltes die Summen der Tagesmitteltemperaturen sowie die Vegetationszeit, Durchschnittstemperatur (1. V. bis 30. IX.) aus langfristigen Beobachtungen hergeleitet. Erstere wurden für die langfristige Periode von 1931 bis 1960 von F. SCHNELLE nach den Unterlagen des Deutschen Wetterdienstes neu berechnet (vergl. dazu XIX. p. 118). Weiterhin wurde die Vegetationszeit nach ihrer Dauer und nach Durchschnittswerten für Temperatur und Niederschlag, wie Gesamtniederschläge und ihre Wirkung im Hinblick auf Luv und Lee deutlich gemacht. Grossklimatisch heben sich die Ober- und Untergrenzen der Waldstufen von Norden nach Süden entsprechend dem Anwachsen der Temperatursummen an. Abweichungen konnten aus relativ geringen Niederschlagsmengen für die Rhön bzw. den höheren des Schwarzwaldes bedeutet werden. Eine natürliche Fichtenwaldstufe kommt nur im Hochharz und in den südöstlich des Harzes gelegenen Gebirgen vor. In den übrigen Gebirgen würde eine natürliche Fichtenwaldstufe mit der Klimaxassoziation nach *Galamagrostis villosa* auf zu hohe Wärmesummen treffen. Hier wird der Fichtenwald durch das *Bazzanio-Piceetum* (*Mastigobryo-Piceetum*) ersetzt. Das trifft im Schwarzwald für die höheren Lagen besonders im Plateau — bzw. Muldenlagen mit Kaltlufteinflüssen zu. Auch im Bayerischen Wald finden sich spezielle *Bazzanio*-Piceeten und *Soldanello montanae*-Piceeten in besonderen Lagen. Kontinentalere Klimanoten bestätigen sich im Ostharz, im Erzgebirge, in den Ostsudeten und im Bayerischen Wald. Hohe Schwankungsbreiten zwischen wärmsten und kältesten Monatsmittel treten hier mit hohen Wintertemperaturen und Sommermaxima an Niederschlägen als Kriterien auf. Schwarzwald und Vogesen zeigen hingegen bis in die hohen Lagen grössere Wärmesummen und Durchschnittstemperaturen für die feste Vegetationszeit von Mai bis September und höhere Niederschlagssummen als in den östlichen Gebirgen des mitteleuropäischen Raumes. Niedrige Wintertemperaturen kennzeichnen weiterhin die östlichen Gebirge (Dezember, Januar, Februar).

Eine Skizzierung der regionalen und lokalklimatischen Verhältnisse — unter Einschluss von mikroklimatischen Untersuchungen, wie sie von Prof. Soó bereits 1928 durchgeführt hat, konnten in dieser Arbeit nur angedeutet werden (vergl. HARTMANN und SCHNELLE 1970, HARTMANN 1972 u.a.).

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EXAMINATION IN PHYTOTRON OF PLANT POPULATIONS GROWING ON ALKALINE PLAINS

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The authors examined the stand structure, course of dry weight increment, and energy utilization of 5 plant communities growing on alkaline plains. Energy utilization, differing considerably (0.4—1.6%) according to stand suggests a correlation with the proportion of grass and the pigment content of the dominant species.

Introduction

The phytotron operated in our botanic garden (HORVÁTH 1972) made possible an attempt to examine in conditioned circumstances natural herbaceous plant populations. After the initial results (HORVÁTH et al. 1972), our examination were extended in 1972 to the plant communities thriving in the alkaline plains around Kiskundorozsma, studied by the junior author since several years (BODROGKÖZY 1959, 1960, 1962). The present study submits the results obtained so far. They refer to the following problems (a) stand structure, (b) course of increment in dry weight, (c) energy utilization.

Material and method

On the alkaline pastures near Kiskundorozsma, the soil and configuration of terrain create sharply distinct plant communities, influenced also to a considerable extent by the annual moisture conditions. The following 5 plant communities have been studied (Soó 1964): *Potentillo-Vestucetum pseudovinae* (Soó/39/50).

The earst while extensive pastures of the sand soils of chernozem character are today mostly agricultural fields. Smaller to larger areas of this habitat survive on the sandhills flanking the flats of the Duna—Tisza region. As a result of the differing habitat-ecological factors, several sub-associational units can be distinguished. The plant stand examined is a *Cynodon dactylon* subassociation arising as a consequence of excessive grazing.

Agrostio-Caricetum distantis (Rapaics 27) Soó 30

In the slightly salty shore zone of the marshy meadows predominating in the desiccating alkaline flats of a solonchak type is under water only for a short time at the time of the spring floods; its several subassociations can

be distinguished mainly on the part utilized for grazing, depending on the ecological conditions.

One of the stands examined is *Agrostio-Caricetum distantis trifolietosum fragiferi* (fac. Slavnic 48) Bodrogközi 60, appearing on slightly alkaline humic soils with favourable water and nutrient supplies.

The other subassociation is essentially poorer in species; *Agrostio-Caricetum distantis plantaginetosum maritimae* (fac. Soó 57). It has a similarly favourable water-supply, but essentially poorer in organic substances, it appears on slightly salty meadow soils.

The fourth plant stand forms in the zones of more strongly sodic, alkaline flats of solonchak soils: *Lepidio-Puccinellietum limosae* (Topa 39) Soó 57 *Lepidietosum crassifolii* Soó 47.

The fifth stand lies in the lowest zone of the alkaline flat, where the water cover has the longest duration *Astero-Agrostetum albae* (Soó 30) Bodrogközy 60 (= *Agrostis alba-Aster pannonicus* ass., Soó 30) forms owing to special hydrographic conditions on its slightly salty meadow soil.

From these plant communities samples of 30×25 cm "grass squares" were cut, to a depth of 15 cm. The grass squares were placed into plastic boxes in the phytotron on 20 September. At the beginning of the examination, the stands were cut back to the surface of the ground, and the species composition, the dry weight according to dominant species in the epigeous phytomass, and the cover were determined.

Illumination in the phytotron was supplied by light tubes of 40 W, F_{33}, for 12 hours daily. The light intensity was of 12 000 lux, which is equivalent to about 10.5 cal $cm^{-2} . h^{-1}$ energy. The daily cycle of temperature was between 20 and 25 °C, while the relative moisture content of the air was between 50 and 70%. CO_2 concentration was constant and it corresponded to the natural concentration (0.03%).

Because of the weight of the grass squares (about 10 kgf), watering according to weight could not be solved, therefore, on the basis of experience, watering was done with a determined quantity of water daily. This with the various stands, in dm^2, was as follows:

Astero-Agrostietum albae	38 ml
Agrostio-Caricetum distantis plantaginetosum maritimae	36 ml
Agrostio-Caricetum distantis trifolietosum fragiferi	35 ml
Lepidio-Puccinellietum limosae lepidietosum crassifolii	35 ml
Potentillo-Festucetum pseudovinae	25 ml

For watering tap-water was used. In comparison with natural precipitation (about 550 mm yearly), this water-quantity was considerable, it amounted to 70—110 mm monthly, yet it did not result in "overmoisturing" of the soil. This was due to the fact that in the phytotron transpiration was increased by the constant, uniform air motion.

Examinations were carried out on October 28, and November 20, 1972, with a harvesting method from half of the area of the grass squares (4.3 dm^2).

Phytosynthetic pigments were extracted from the fresh material with 1 ml/50 mg acetone. Washing for 10 ml final volume was done with petrol-ether.

Absorption of this photosynthetic pigment extract was measured between 400 and 700 mm, with a UNICAM SP 800 registering spectrophotometer.

The quantity of chlorophylls was determined according to ZIEGLER—EGLE (1965), with the following equation:

$$\text{chl. a} + \text{b} = 7.01.\ A_{664} + 17.76_{647}\ \text{mg} \cdot l^{-1}.$$

Results

The structure of the stand

The extent of the cover was determined by an exact mapping (drawn on a glass plane) of the area covered by the individuals constituting the stand. The values are as follows:

	%
Astero-Agrostietum albae	21
Agrostio-Caricetum distantis plantaginetosum maritimae	71
Agrostio-Caricetum distantis trifolietosum fragiferi	23
Lepidio-Puccinellietum limosae lepidietosum crassifolii	72
Potentillo-Festucetum pseudovinae	75

The extent of cover practically did not change during the time of examination (no forced lateral shoot production occurred, no fresh seedlings grew).

Another important factor in the structure of the stand namely, the proportion of the species in relation to one another, did, however, change during the two months' experimental period. This can be attributed partly to the conditions in the phytotron, partly to the natural processes following from the diverse growth dynamisms of the different species.

The results are summarized in Table I. It should first be pointed out that the five kinds of stand behave differently in the phytotron, which is expressed in the epigeous dry matter production and in the ratio of the species between one another. As a basis of comparison the values measured at the commencement of the experiment were taken, as these values were obtained in field conditions.

Table 1

Association and species	g/dm²			%		
	sept. 20	okt. 28	nov. 20	sept. 20	okt. 28.	nov. 20
Astero-Agrosthetum albae						
Agrostis alba	1.15	0.60	1.16	93	58	65
Aster pannonica	0.08	—	0.08	7	—	4
Juncus compressus	—	0.44	0.48	—	42	27
other	—	—	0.08	—	—	4
total	1.23	1.04	1.78	100	100	100
Agrostio-Caricetum distantis plantaginetosum maritimae						
Plantago maritima	0.66	0.34	0.65	64	77	81
Carex distans	0.12	0.03	0.02	12	7	2
Lotus tenuis	0,11	—	0.11	11	—	15
other	0.13	0.07	0.02	13	16	2
total	1.02	0.44	0.80	100	100	100
Agrostio-Caricetum distantis trifolietosum fragiferi						
Cynodon dactylon	0.84	0.59	1.88	35	46	60
Trifolium fragiferum	0.75	0.29	0.62	32	23	20
Bromus mollis	—	0.32	0.60	—	25	19
other	0.79	0.07	0.04	33	6	1
total	2.38	1.28	3.14	100	100	100
Lepidio-Puccinellietum limosae lepidietosum crassifolii						
Puccinellia limosa	0.79	0.58	1.52	93	80	80
Lepidium crassifolium	0.01	0.12	0.19	1	17	10
Plantago maritima	0.05	0.02	0.05	6	3	3
other	—	—	0.13	—	—	7
total	0.85	0.72	1.89	100	100	100
Potentillo-Festucetum Pseudovinae						
Festuca pseudovina	0.85	0.12	0.08	51	26	4
Medicago falcata	0.14	0.12	0.32	8	26	15
Poa angustifolia	—	0.11	0.37	41	24	18
other	0.67	0.11	1.30	41	24	63
total	1.66	0.46	2.07	100	100	100

During the two months' experimental period, the epigeous dry weight per areal unit surpassed those measured at the start of the experiment, — with the exception of one association, namely the *Agrostio-Caricetum distantis plantaginetosum maritimae* —, but this exception was also hardly smaller.

The increase in dry weight is of the greatest extent — more than 100% — with the stand *Lepidio Puccinellietum limosae lepidietosum crassifolii.*

The change in species composition can be characterized on the basis of dry weight ratios. This change was of the greatest extent in *Potentillo-Festucetum pseudovinae*, in which the dry weight of *Festuca pseudovina* dropped from 51% to 4%, hence the stand changed in its character. On the other hand, *Lepidio-Puccinellietum limosae lepidietosum crassifolii* hardly changed. With the weight ratio of *Puccinellia limosa* having dropped only by about 10%, while that of *Lepidium crassifolium* increased by 10%.

Change in the dry weight ratios also allows inferences on the extent of experimental conditions effecting the various species.

It can be seen that this effect is of a small extent on *Trifolium fragiferum*, *Plantago maritima*, and *Aster pannonicus* besides *Puccinellia limosa* which has already been mentioned, that is, their weight ratio hardly changes. On the other hand, *Juncus compressus*, *Cynodon dactylon*, *Bromus mollis*, and *Poa angustifolia* have considerably come to the fore. The weight ratios in *Agrostis alba* and *Carex distans* considerably dropped.

The course of dry weight increase

The course of change in the epigeous dry weight of the stands shows two types. In one type, it is evenly increasing during the two months' experimental period, e.g. in *Astero-Agrostietum albae*, and *Agrostio-Caricetum distantis plantaginetosum maritimae*. The course of dry weight is gradually increasing

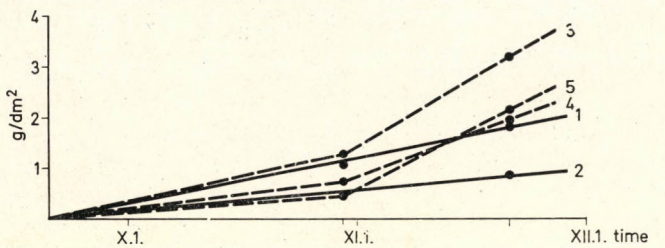

Fig. 1. Course of the change in dry weight of the epigeous phytomass

in the stands of *Agrostio-Caricetum distantis trifolietosum fragiferi*, *Lepidio-Puccinellietum limosae lepidietosum crassifolii*, and especially in *Potentillo-Festucetum pseudovinae* (See Fig. 1). As an example, it may be mentioned that in the latter stand the daily dry weight increase in the first month was 120 mg/dm², while in the second month 730 mg/dm².

The course of the dry weight increase is always determined by the dominant 1—2 species.

Energy utilization

When calculating the photosynthetic energy utilization of the stands, we related to cultivation area (dm^2) and took the energy value of 1 g plant dry matter as 4000 cal on the average.

The energy utilization of the stands related to the two months' experimental period was as follows:

	%
Astero-Agrostetum albae	0.9
Agrostio-Caricetum distantis plantaginetosum maritimae	0.4
Agrostio-Caricetum distantis trifolietosum fragiferi	1.6
Lepidio-Puccinellietum limosae lepidietosum crassifolii	1.0
Potentillo-Festucetum pseudovinae	1.1

The extreme values of energy utilization are seen in the two subassociations of *Agrosti-Caricetum distantis*, the departure of the two is fourfold. By talking also cover into consideration, it can be inferred that energy utilization showes — at least within certain limits — an inverse connection with it. This does not hold for different associations, since energy utilization in the stands examined is almost identical, despite the almost fourfold differences in cover.

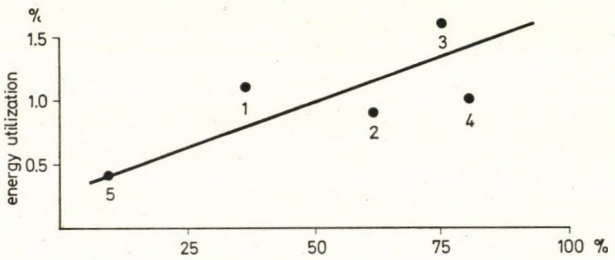

Fig. 2. Correlation between the participation ratio of grasses and energy utilization

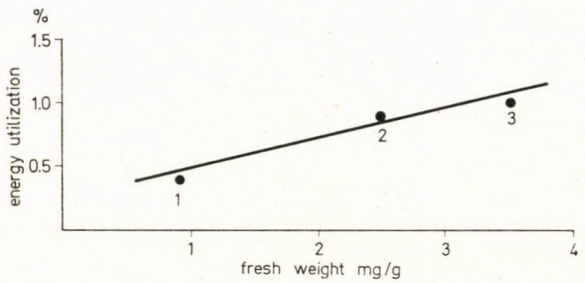

Fig. 3. Correlation between the pigment content of the dominant species and energy utilization

In examining the role of monocotyledons and dicotyledons in energy utilization, it can be seen that the greater is the ratio of grasses, the higher is the rate of energy utilization, and the correlation is nearly linear. This refers especially to plant stands containing soboliferous species, for example *Cynodon dactylon* (Fig. 2.).

Energy utilization shows a correlation with the pigment content of the dominant species as well. Higher pigment content entails higher energy utilization (Fig. 3.).

Summary

Stand structure, the course of dry matter increment, and photosynthetic energy utilization were examined in phytotron with five kinds of alkaline plant stand.

An illumination of 12 000 Lux (through F_{33} light tubes) was supplied for daily 12 hours at 20—25 °C; the relative vapour content of the air varied between 50 and 70%; CO_2 concentration was constant, and it corresponded with the natural concentration (0.03%).

The examinations were conducted for two months. It can be stated that

1. The rate of cover remained practically unchanged in all plant stands (no forced lateral growth occurred, no fresh seedlings appeared).

2. The change in the species composition was especially significant in *Potentillo-Festucetum pseudovinae*, while in *Lepidio-Puccinellietum limosae lepidietosum crassifolii* the composition remained practically unaltered.

3. The difference manifesting in photosynthetic energy utilization is significant (fourfold). This is related primarily with

(a) the proportion of grasses in the stand, and

(b) the pigment content of the dominant species.

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COMPARATIVE SPORE MORPHOLOGICAL EXAMINATIONS IN FUNARIA AND PHYSCOMITRIUM SPECIES

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Comparative spore morphological examination of some *Funaria* species and *Physcomitrium pyriforme* is given.

The results support the correct relegation of *Funaria hungarica* to the genus *Funaria*, on the basis of spore morphological differences from *Physcomitrium pyriforme*.

As is known, *Funaria hungarica* was discovered by Á. BOROS, the excellent bryologist. He collected it first in 1919, but dated the recognition of the new species from 1923, then described it in 1924 (BOROS 1924).

The species was subsequently found in several localities in the Great Hungarian Plain, in the Rumanian Plain and in Ukraine. Twenty years after the discovery, its contiguous area was also drawn (BOROS 1943).

In the meantime, however, several scientific papers contended the similarity between or the identity of, *Funaria hungarica* and *Physcomitrium pyriforme* (Győrffy 1928, 1934; Loeske 1929; 1935; Gams 1934; Boros 1943, 1945).

Routine morphological examinations eventually justified BOROS's standpoint. On the basis of the whole margin of the leaf, the peristomium and paraphyses of different shape, *Funaria hungarica* can unambiguously be separated from *Physcomitrium pyriforme*.

In recent decades, the employment of microscope techniques, as for example light microscopes of high performance, the transmission and scanning electron microscope, increases steadily the possibilities of micromorphological examinations, thus also those of spore-pollen morphological studies. It is increasingly desirable that in describing plants for whatever purpose, e. g. when deciding taxonomical questions, spore-pollen morphological characteristics should also be taken into consideration. These are at least at identical value with the other morphological features of the plant, since the spore and the pollen are known as the most conservative parts of the plant.

Their taxonomical importance has already been testified by several publications. In these the complete pollen morphological elaboration of not only species, but entire genera, families, and even higher alliances has been

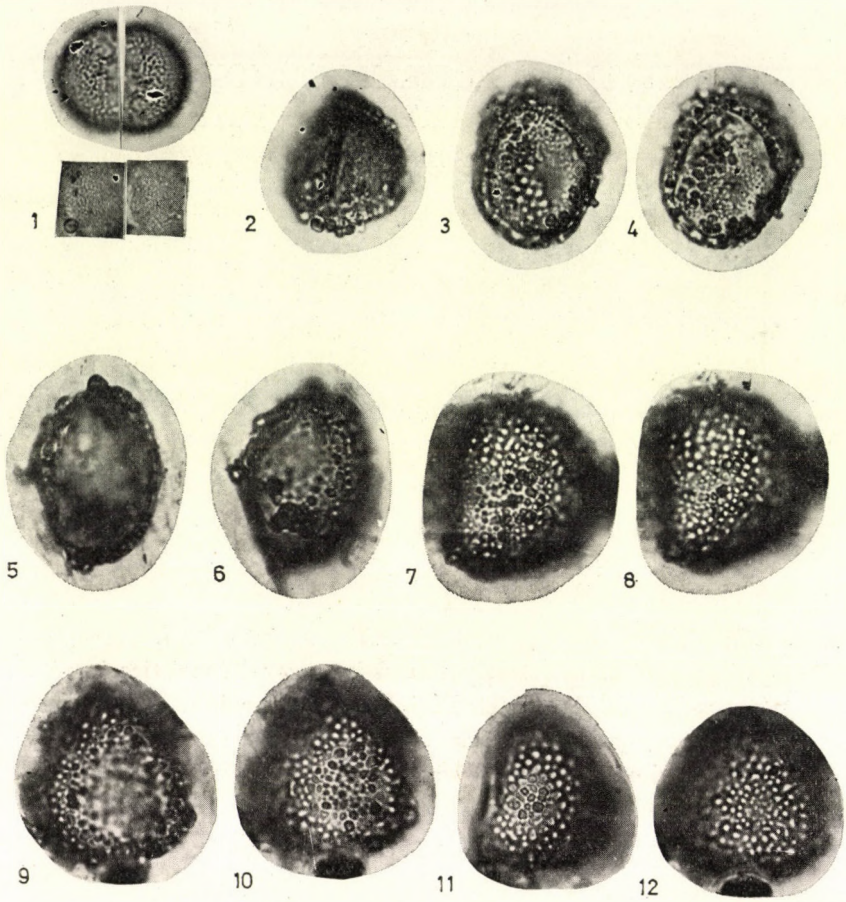


Plate I. 1—4. *Funaria hygrometrica.* 5—12. *Funaria fascicularis.* 1. Parts of basic pattern. 2—12. Entire sculpture. Both in different optical sections (×1000)

presented, for both recent and fossil plants. Even an incomplete enumeration of these works would be too voluminous, therefore reference is made only to a few comprehensive works containing largely the results of the examinations mentioned above (WODEHOUSE 1959; ERDTMAN 1952, 1957, 1963, 1965; CHADEFAUD 1955; CHANDA 1966; CUTLER and AIRY SHAW 1965; KUPRIANOVA 1948; WALKER 1971).

The present study deals with comparative spore morphological examinations on the spores of some species of the genus *Funaria* (*F. dentata*, *F. hygrometrica*, *F. fascicularis*, *F. hungarica*), and of *Physcomitrium pyriforme*. It was intended to lend support from the perspective of more than twenty years to the results of the morphological examinations and the systematic establishment of *Funaria hungarica*.

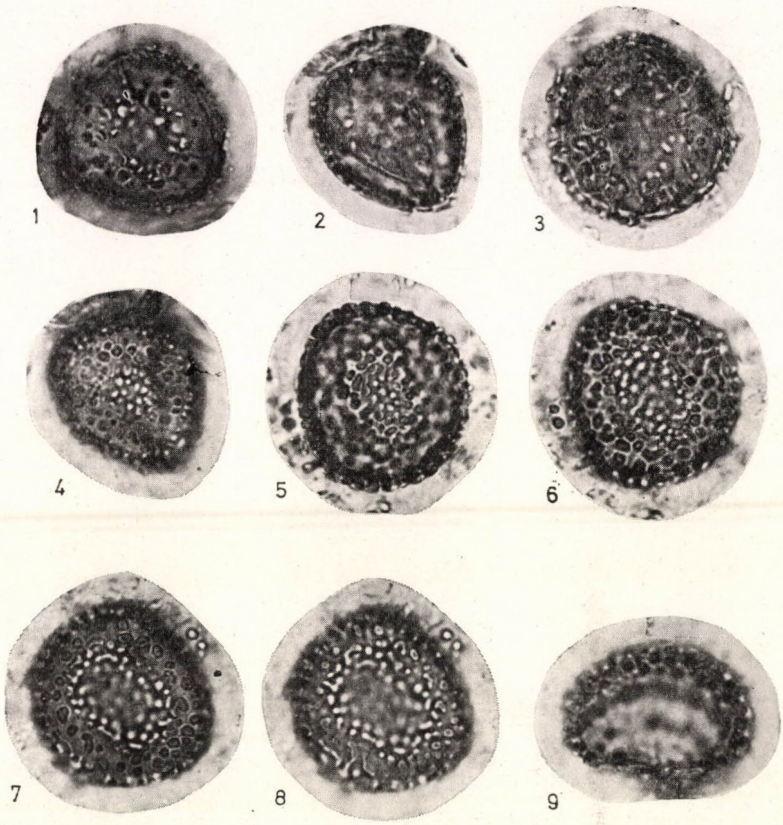


Plate II. Funaria dentata. 1—3. cf. proximal face of the spore with leptoma-like area. 4—8. Sculpture of the spore in different optical sections. All from polar view. 9. Shape of the spore from equatorial view. (×1000)

Material and methods

The moss spores examined originate from the herbarium of Á. BOROS. For the determination of the measures and morphological characteristics 30 samples from each of the species were used.

The examinations were made with and the microphotographs taken by NU Zeiss-type light microscope and JSM 50A-type scanning electronmicroscope.

For the light microscopical study the spores were treated by an acetolysis process (ERDTMAN 1943, 1952). As regards the preparations for photographing by scanning electron microscope, as well as the taking of the photographs, the Parisian Centre of JEOLCO has kindly came to help and placed the photographs at our disposal.

In the description we used ERDTMAN's nomenclature (ERDTMAN 1952, 1969; KREMP 1968).

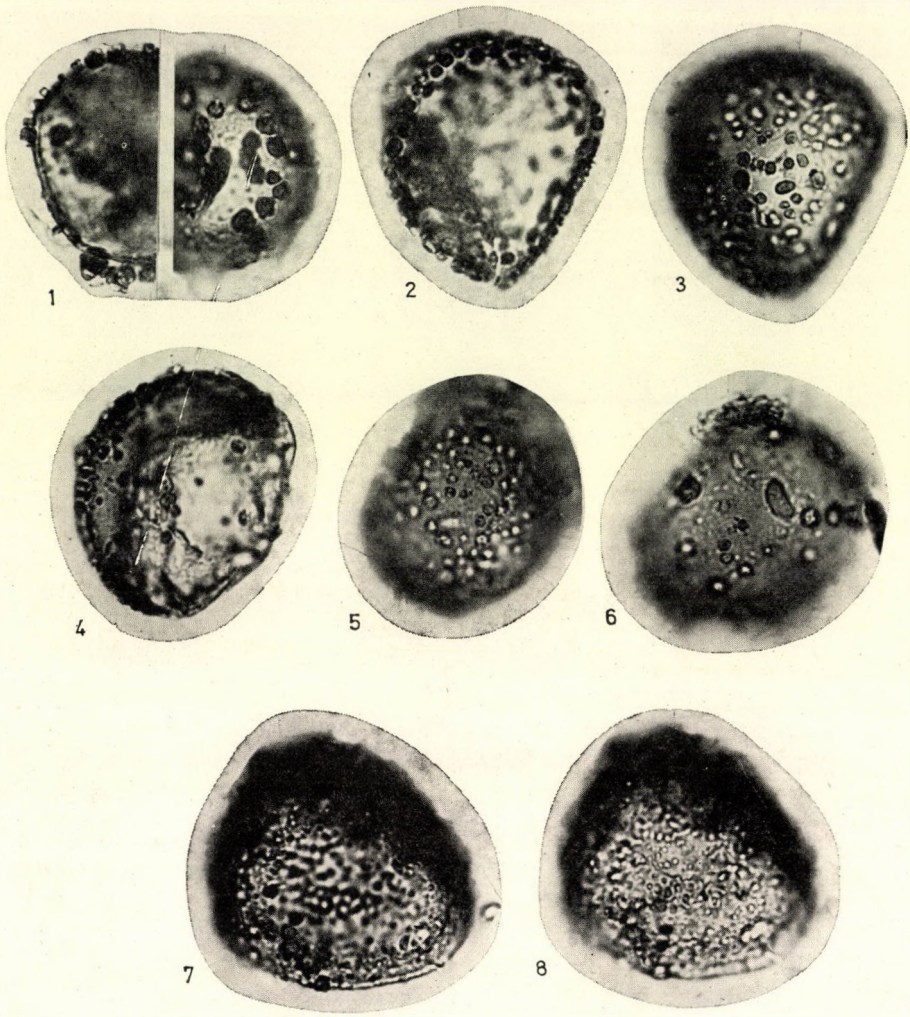


Plate III. 1—8. *Funaria hungarica.* Sculpture of the sexine in several positions and different optical sections. (×1000)

Results

The spores of *Funaria* species are usually subtriangular. Exine is about 1 μ thick without processes. The spores are cf. katalept, because a thin-walled, often wrinkled leptoma-like area can be seen in one (cf. proximal) face of them, which may serve as a leptoma. Among the four species, *Funaria hygrometrica* is the smallest one, the mean value of its diameter is about 16 μ. *Funaria hungarica* has the biggest spores with a diameter about 34 μ. The two others

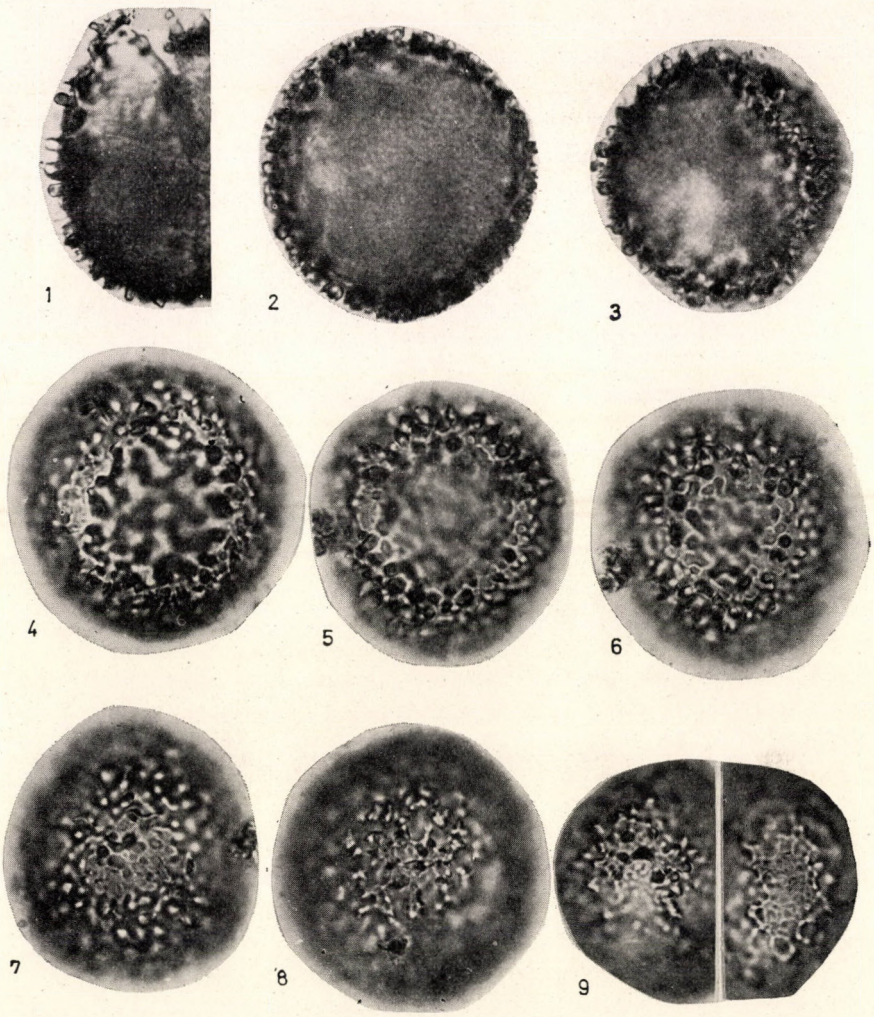


Plate IV. 1—9. *Physcomitrium pyriforme.* 1—3. Ornamental elements of the spore. 4—7. Sculpture of the spore showing the amalgamation of the elements in different optical sections. 8—9. Optical section of the highest part (top) of elements showing a reticulum-like pattern. (×1000)

(*F. dentata*, *F. fascicularis*) are similar to each other in measurements and as they are usually plane-convex, the mean value of their diameters is about 22×25 μ.

The main types of ornamental elements of the sexine in the genus *Funaria* are verrucae and granula forming a so-called "basic pattern" on which easily loosening globules are scattered. The diversity among the ornamentations of the different species is given in the formation of basic pattern and in the measurements and arrangements of globules on it as follows:

Funaria hygrometrica (L.) Sibth. has a sexine with very delicate, regularly arranged and densely spaced verruca- or pilum-like processes, which form a delicate, dotted basic ornamentation. Very often easily loosening globules or bigger verrucae (diameter up to 2 μ) are scattered on it in one face of the spore. Elements are mostly circular in optical cross-section. *F. hygrometrica* has the most delicate ornamentation among the examined four species (Plate I. 1—4).

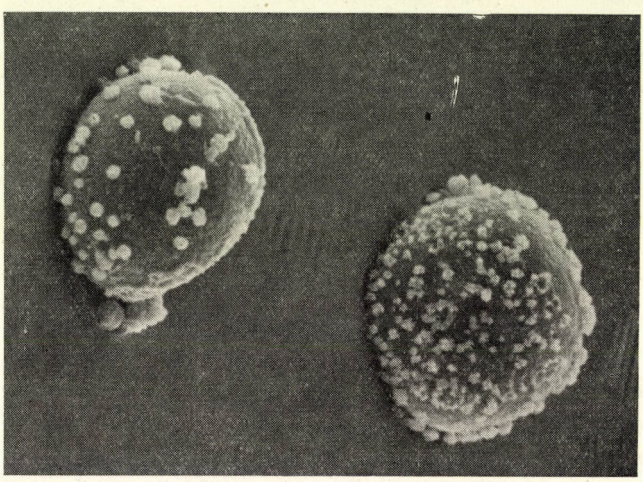


Plate V. 1

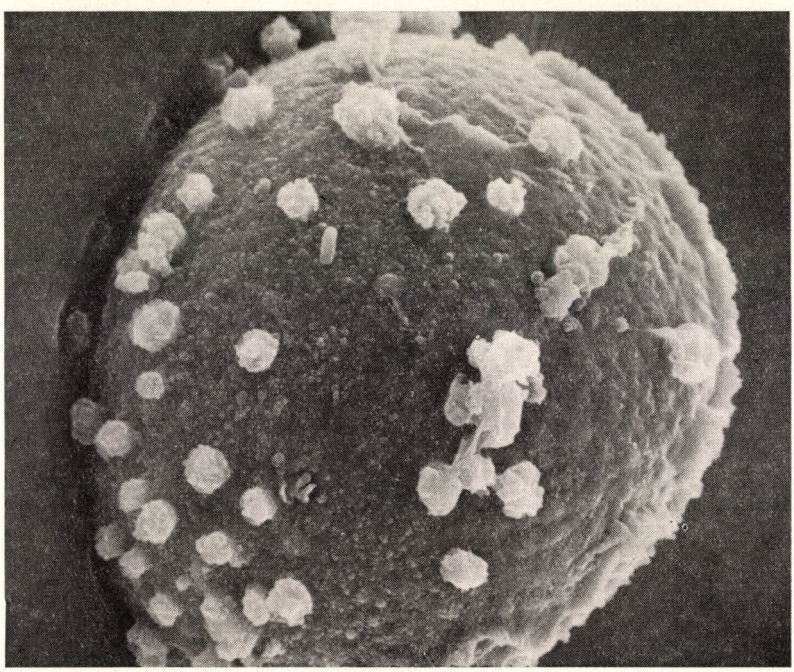


Plate V. 2

Funaria fascicularis (Dicks) Schimp. has a coarse, distinct sexine pattern produced mostly by verruca-like processes, widely varying in size and shape. They are angular in optical cross-section (Fig. 1). The diameter of them is from 0,5 μ to 3μ, their length from 1μ to 3μ. Bigger angular processes are irregularly scattered on the basic pattern. There is a usually finer pattern in the flattened face of the spore (Plate I, 5—12).

The sexine of *Funaria dentata* Crome is also very coarse due to the verruca- or gemma-like processes of various size and shape. They are often amalgamated into small groups (Fig. 2.). Leptoma-like area bearing face is less ornamented, more finely verrucose. Although the measurements of *F. fascicularis* and *F. dentata* are similar, the processes of *F. dentata* are more homogenous, the ornamentation is more regular, and the amalgamation of verruca- or gemma-like elements is more frequent than those of *F. fascicularis* (Plate II).

Funaria hungarica Boros has a fine granulate basic pattern, overlaid with bigger (up to 3—4 μ in diameter), irregularly angular bodies of various size (granula). In one face of the spore smaller, in the other face bigger processes are more frequent. Processes occasionally fit into the surface with a very small neck (Fig. 3). This is the biggest spore, and it has the largest processes,

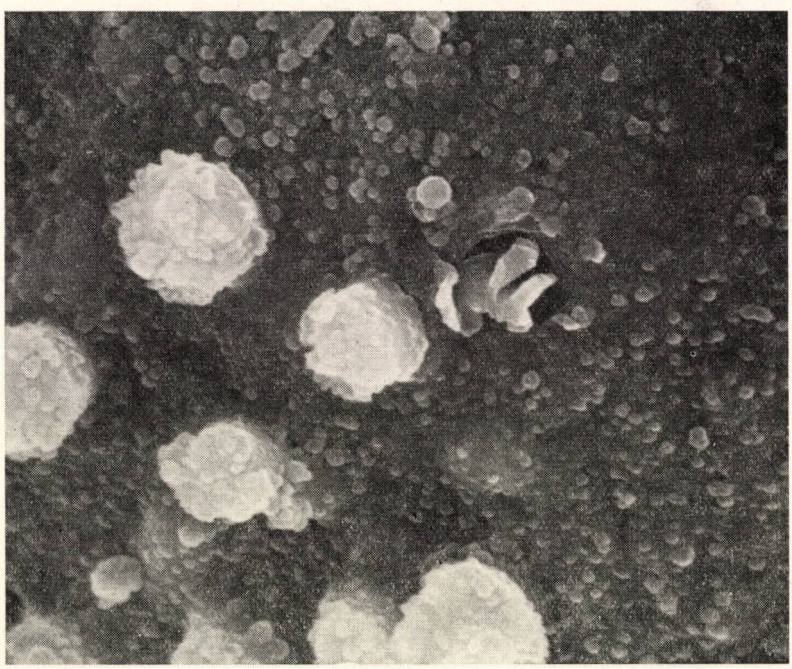
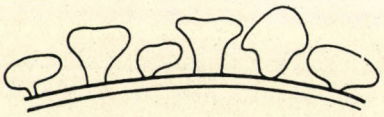
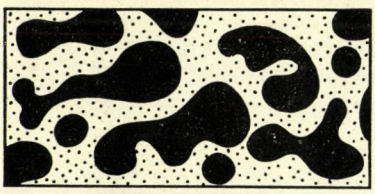


Plate V. 3

Plate V. Scanning micrographs of the spore of *Funaria hungarica*. 1. Two different faces of the spore. 2—3. One face with less but bigger globules on the densely granulated basic pattern.



1



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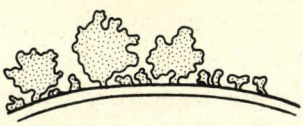

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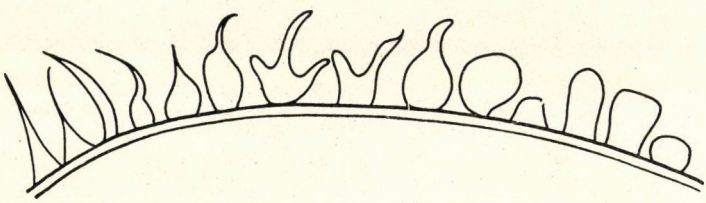

4

Figs 1—4. Ornamental elements of sexine. 1. *Funaria fascismalularis;* 2. *Funaria dentata* amalgamation of elements); 3. *Funaria hungarica;* 4. *Physcomitrium pyriforme*

the most distinct and peculiar pattern among the examined species (Plate III, V, VI,).

Physcomitrium pyryforme (L.) Brid. has spheroidal spores the size of which is about 37 μ (mean value of diameters). Although in one face of the spores there is sometimes a flattened or slightly concave area (implying that this may serve as a leptoma, so the spores are cf. katalept), this is usually less distinct than in *F. hungarica*. The exine of *P. pyriforme* is about 1 μ thick (processes not included). The sexine consists of densely spaced, 2—4 μ long spinula-, bacula-, or verruca-like processes, and of an interesting transition between the forms of the elements (Fig. 4). Processes are partially united into an irregular reticulum or "broken"-reticulum (Plate IV).

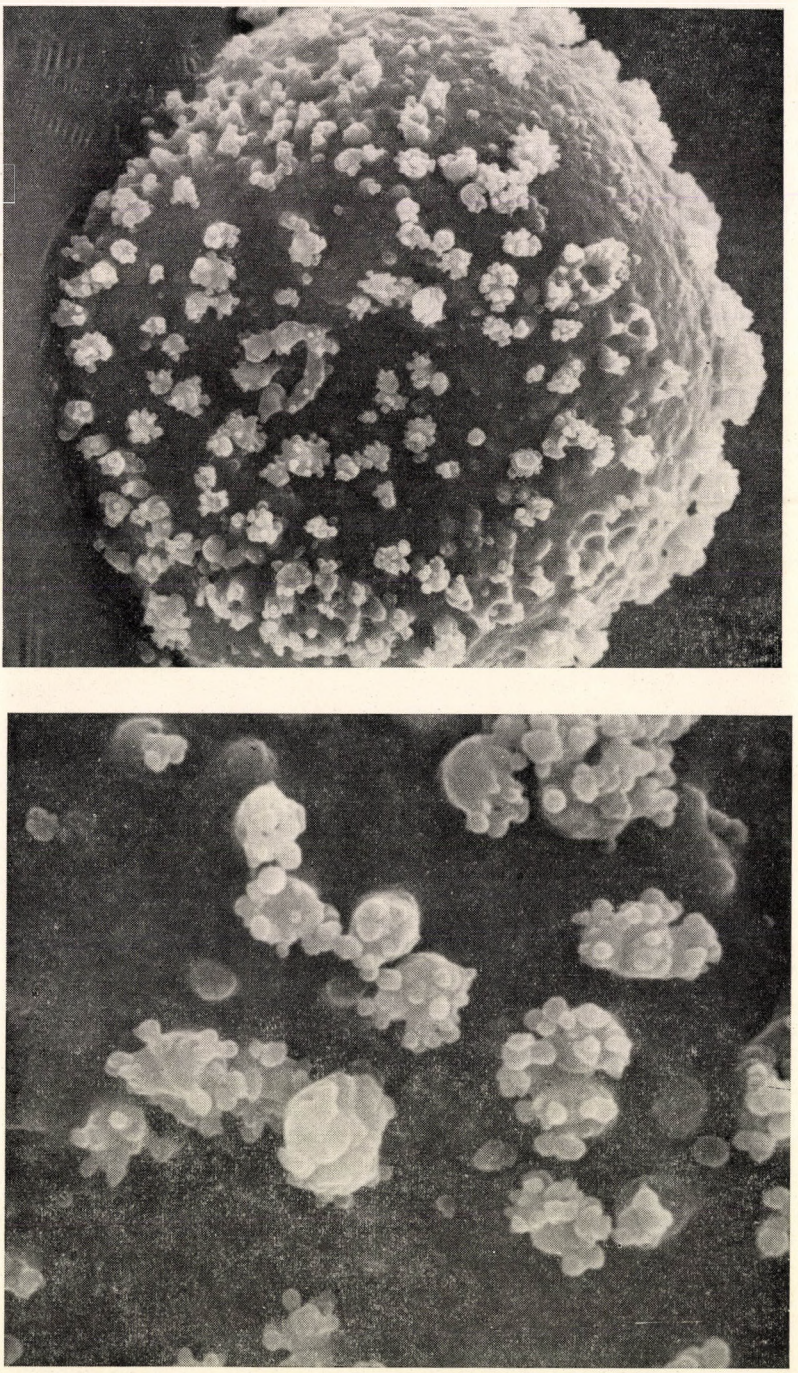

Plate VI. Scanning micrographs of the spore of *Funaria hungarica*. One face of the spore with densely spaced globules

Discussion

The result of the spore morphological examinations reveal essential morphological differences of the spores of *F. hungarica* and *P. pyriforme*. The form of the spores of *F. hungarica* is subtriangular. The elements of ornamentation are granules. On the finely granulate basic pattern there are bigger, irregularly angular easily lost bodies. The ornamentation of the two faces of the spore (cf. proximal, cf. distal) is essentially different with respect to the size of the ornamentation elements, their density and arrangement.

The form of the spores of *P. pyriforme* is spheroidal. Their elements of ornamentation are various but they are not granules; mainly spinules, bacules or transitions of varying form of the two, as well as verrucae. There are no bigger, easily lost bodies on the basic pattern. The whole surface of the spore is uniformly ornamented.

However, *F. hungarica* fits spore morphologically well into the genus *Funaria*. The species examined are identical in form and structure; their elements of ornamentation are identical, while in measure and the arrangement of the elements of ornamentation the various species differ from each other.

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DIE ANWENDUNG DER TWR-INDIKATORKONZEPTION AUF WASSER- UND- AUEN-ÖKOSYSTEME

Von

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(Eingegangen am 1. Januar 1973)

The indication of the place of origin will be — similarly as the TWR numbers — the conception of indication on the abstracted species, which are analyzed with mathematical-statistical methods and used as information deducible on the conformity with natural laws of the ecosystem. The data from numerous coenological surveys on the basis of mean values, and from the analyses carried out on the emerging species make various aspects of information to be obtained. The changes in the indicator values of the various oecological factors (temperature, water metabolism, chemical reaction), with reference to biounit, especially cenotypes, as we showed for example in connection with the water- and deposit biounits give useful information for synecologic investigations. The obtained data show also the clue for the mechanism of the water metabolism.

Die Anzeige des Standorts durch Pflanzenarten ist sowohl theoretisch als auch in ihrer praktischen Anwendung seit vielen Jahrzehnten bekannt und bewährt.

Auf dem Gebiet der Indikatorkonzeption wurde ein bedeutender Schritt getan, als die TWR-Zahlen, von den Arten abstrahiert, nach mathematisch-statistischen Methoden analysiert, als aus den Gesetzmässigkeiten der Ökosysteme ableitbare Information eingeführt wurden (ZÓLYOMI 1963). Die Analyse aufgrund der Mittelwerte der Daten zahlreicher zönologischer Aufnahmen und der in der Aufnahme vertretenen Arten ermöglicht eine vielseitigere Information.

Im Anschluss an derartige Forschungen in Ungarn (SOÓ 1964, 1968, 1970, ZÓLYOMI 1963, 1964, ZÓLYOMI — BARÁTH — FEKETE — JAKUCS — KÁRPÁTI, I. — KÁRPÁTI, V. — KOVÁCS M. 1967, KÁRPÁTI, I. — KÁRPÁTI, V. 1966, KÁRPÁTI I. — KÁRPÁTI V. — BORBÉLY 1968, KOVÁCS 1969 usw.) haben wir in jüngster Zeit den Zeigerwert von Wasser- und Auen-Ökosystemen untersucht.

Methodisches Fragen

Die Reihen wurden aufgrund der wichtigsten Standortscharakteristika aufgestellt. Über die Einreihung der T-, W- und R-Zahlen berichtet ZÓLYOMI (1964).

T-Zahl

Die Verwendung der T-Zahle ist beim Vergleich der sonstigen wichtigen Faktoren von grundlegender Bedeutung. ELLENBERG hat eine fünfstufige Skala aufgestellt.

Die von B. ZÓLYOMI ausgearbeitete und in Ungarn angewendete T-Zahl-Skale hat 10 Stufen. Sie ermöglicht die der Pflanzenarten aller klimatischen Zonen unserer Erde. Als Aufteilungsbasis die klimatische Zonenverteilung der Erde:

T 1: Eis, Tundra (Kältewüste)
T 2: Waldtundra
T 3: Taiga
T 4: Nadel-, Laubmischwald (Ostküste, Monsun-Mischwald, kühlkontinentale Steppe)
T 5: Laubwald, subkontinentale-atlantische mässig kontinentale Steppen-Halbwüste
T 6: Submediterraner Laubwald, warme Steppe
T 7: Mediterran-atlantischer Immergrünwald, Monsunwald
T 8: Mediterran-kontinentale warme Steppe und Halbwüste
T 9: Tropische heisse Savanne und Wüste
T 10: Subäquatorialer Wald, äquatorialer Urwald

W-Zahl

Die Wasserhaushaltsskale wurde von B. ZÓLYOMI aufgrund der 5-Stufenskala POGREBNJAKs zu einer Skala mit 10 Stufen umgewandelt. Diese wurde wiederum von I. KÁRPÁTI modifiziert, indem er in die 11. Stufe die Wasserpflanzen einreihte.

W 0: extrem trocken
W 1: sehr trocken
W 2: trocken
W 3: mässig trocken
W 4: mässig frisch
W 5: frisch
W 6: mässig feucht
W 7: feucht
W 8: mässig nass
W 9: nass
W 10: sehr nass
W 11: Wasserpflanzen

R-Zahl

Die R-Skale, die die Zahl der Bodenreaktionen ausdrückt, entnahmen wir den Werken von ELLENBERG (1950) und WALTER (1951). Die R-Zahl ist eine wichtige Einordnung, aus der bis zu einem gewissen Grad auch auf die Versorgung des Bodens mit Nährstoffen gefolgert werden kann.

R 1: Arten, die auf Standorten mit säueren Böden leben (Aziditätskennwert)
R 2: Arten, die auf schwach säuren Böden vorkommen
R 3: Arten, die nahezu neutrale Böden bevorzugen
R 4: eher Kalk bevorzugende Arten mit weiterer ökologischer Amplitude
R 5: kalkliebende Arten auf sehr basischen Böden (Kalkanzeige!)
R 6: gegen die Bodenreaktion nicht empfindliche Arten

Die Einreihung der im Wasser und in Überschwemmungsgebieten befindlichen Pflanzenarten wurde in einer von ZÓLYOMI geleiteten Arbeitsgemeinschaft durchgeführt und zu einem grossen Teil von uns allein. Darüber hinaus werden Laichkraut- und hygrophile bzw. mesophile sonstige Arten in mehreren kleinen Arbeiten und Manuskripten erwähnt.

Die Daten der ökologischen Einreihungen haben wir auf die später vorzustellenden Ökosysteme bzw. Bioeinheiten bezogen. Aus einer aufgrund der zönologischen Aufnahmen angefertigten tabellarischen Zusammenfassung wurden gewogene Mittelwerte berechnet und in zweiachsigen Koordinatensystem übertragen. Aufgrund der durch die Bioeinheiten begrenzten Fläche kann auf die Standortsindikation des gegebenen Faktors bzw. auf die ökologische Amplitude der Bioeinheit gefolgert werden. Daraus können die durch die Bioeinheit angezeigten wichtigen TWR-Zahlen im einzelnen abgelesen werden.

Die Ausbildung der mittleren Indikatorzahlen in einzelnen Bioeinheiten

Zum Erfassen der charakteristischen Indikatorzahlen der in einzelnen Wasser- und Uferzonen befindlichen Bioeinheiten wurden eigene zönologische Aufnahmen und die ungarische Fachliteratur (TÓTH, SIMON, JURKO etc.) verwendet. Die Ergebnisse werden in zwei (TW und WR) Koordinatennetze vorgestellt.

Die Ausbildung der mittleren Indikatorzahlen im TW-Koordinatensystem in verschiedenen Bioeinheiten

Mit Hilfe vielgliedriger Datenreihen kann festgestellt werden, dass sich die T-Zahlen der im Wasser ausgebildeten Laichkraut-Ökosysteme und der in Überschwemmungsgebieten befindlichen azonalen Bioeinheiten um 5 gruppieren. Das bezieht sich gleichermassen auf die in stehenden Wässern ausgebildeten Systeme und auf die Schilf-Bioeinheiten:

Bioeinheit	Tx
Lemna Bioeinheit	5.0—5.5
Trapa natans Bioeinheit	5.0
Nymphaea alba Bioeinheit	5.0—5.2
Potamogeton perfoliatus Bioeinheit	5.0—5.7
Phragmites-Carex Bioeinheit	5.0—5.2
Typha Bioeinheit	5.0
Phragmites communis Bioeinheit	5.0

Ähnliche sind die mittleren T-Zahlen der Auenwälder. Das bezieht sich auf die Weiden-Pappel-Wälder in niederen neuholozänen Schichten der Überschwemmungsgebiete und die Strauchweiden ebenso auf die auf neuholozänen höheren Schichten der Misch-Auenwälder (Abb. 1—3.)

Bioeinheit	Tx-Amplitude
Salix triandra Bioeinheit	(4.2) 4.9—5.3 (6.2)
Salix alba Bioeinheit	(4.5) 4.9—5.4 (5.3)
Fraxinus pannonica-Ulmus Bioeinheit	4.9—6.7

Diese Gesetzmässigkeit ist auch bei den Sumpf- und Mähwiesen auf Standorten der Auenwälder zu beobachten (Kovács 1970. ined.).

Bioeinheit	Tx Amplitude
Alopecurus pratensis Bioeinheit	4.8—5.1
Festuca pratensis Bioeinheit	4.9—5.2
Deschampsia caespitosa Bioeinheit	4.9—5.2
Arrhenatherum elatius Bioeinheit	4.9—5.3

Im TW-Netz geschieht eine Verschiebung in Richtung der W-Achse (Abb. 1). Deren Gliederung beschreibt, vom offenen Wasser zu den Uferzonen fortschreitend, die Amplitude der W-Zahl der Ökosysteme mit unterschiedlicher Wasserversorgung, die auch überflutungsfest sind. (Abb. 1—3.)

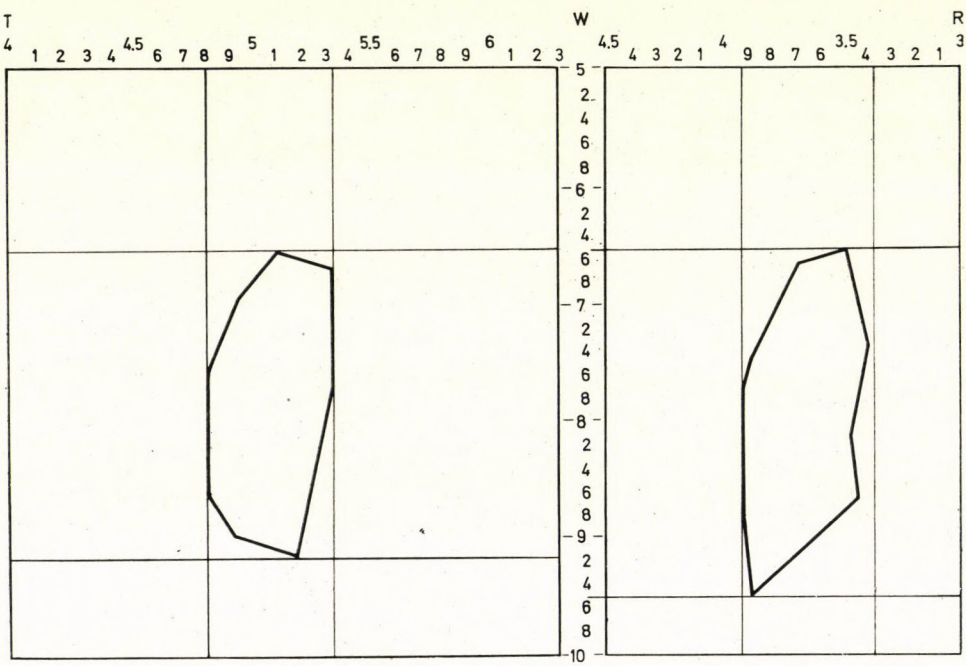

Abb. 1. Salicetum triandrae

Die sich in den *Potamogeton perfoliatus* und *Nymphaea alba*-Bioeinheiten in der Amplitude der W-Zahlen zeigenden nicht charakteristischen unteren Extremwerte (Wx 8,8; 9,1;) ergeben sich daraus, dass in einzelnen Beständen mit geringerem Gewicht Artenelemente der Sumpfvegetation aus der folgenden Sukzessionsstufe auftraten. Das bewirkt eine Umkehrung der auf die Bioeinheit bezogenen mittleren Indikatorzahlen.

Geomorphologische Bioeinheit-Verhältnisse		Wx-Amplitude
Strombett-Niveau	*Nymphaea alba* Bioeinheit	(9.1) 10.2—11.0
(ständiges Wasser)	*Potamogeton perfoliatus* Bioeinheit	(8.8) 10.0—11.0
	Lemna-Phragmites communis Bioeinheit	10.0—11.0 10.0—10.8
Untiefen und neuholozäne niedere Schichten (zeitweilig überflutet)	*Typha* Bioeinheit *Phragmites-Carex*	10.0—10.5 9.3—10.7
neuholozäne niedere Schicht	*Salix triandra* Bioeinheit	(4.7) 6.6— 9.2 (9.5)
	Salix alba Bioeinheit	5.2— 9.4
neuholozäne höhere Schicht	*Fraxinus pannonica Ulmus* Bioeinheit	(3.6) 4.0— 6.7 (8.5)

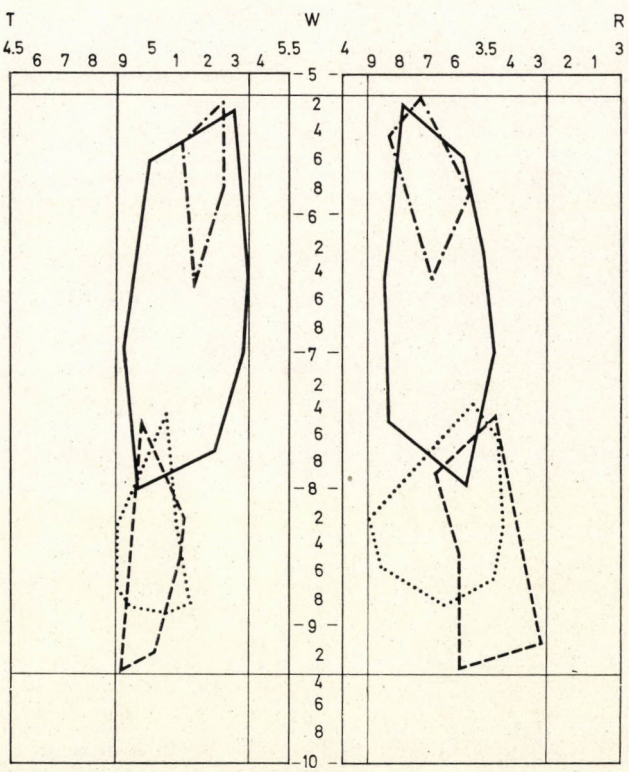

Abb. 2. Salicetum albae-fragilis — — — myosotidetosum; · · · · caricetosum; ———— cornetosum sanguineae; — · — · — calamagrostetosum epigei

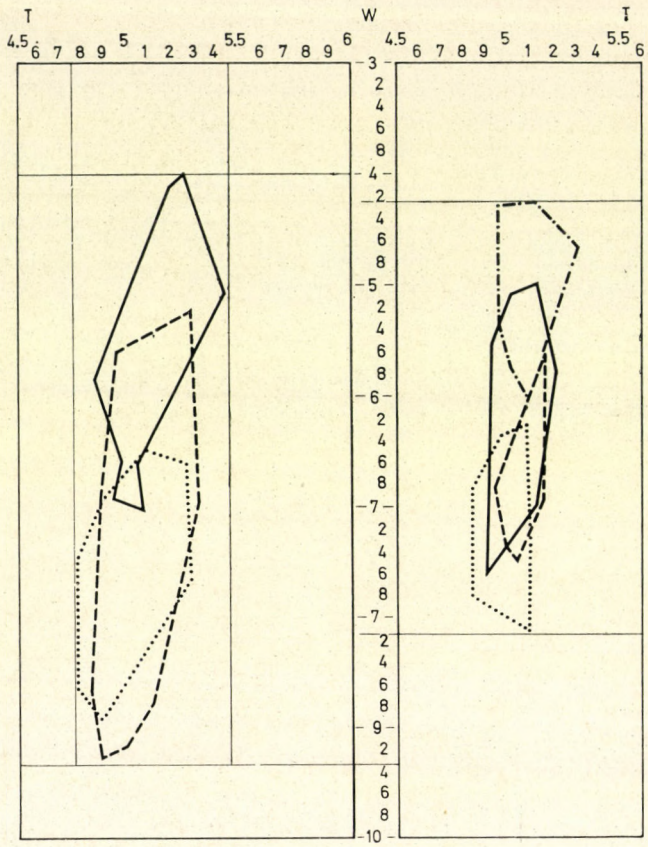

Abb. 3. 1. *Fraxino pannonicae-Ulmetum* ————, 2. *Salicetum albae fragilis* — — —, 3. *Salicetum triandrae* · · · ·,
1. *Alopecuretum pratensis* · · · ·, 2. *Festucetum pratensis* ————, 3. *Deschampsietum caespitosae* — — —, 4. *Arrhenatheretum elatioris* — · — · — (KOVÁCS M. 1970 ined.)

Die W-Zahl-Amplituden einiger zonal aneinander angeschlossener Bioeinheiten können sich decken. Das ist eine natürliche Erscheinung, da doch in den Überflutungszonen infolge des Übergangs der Standortverhältnisse in einem schmaleren oder breiteren Streifen Überschneidungen auch in Wirklichkeit vorhanden sind. Die von dem W-Zahlen der *Salix triandra*- und der *Salix alba*-Bioeinheit eingenommenen Flächen decken sich (*Salix triandra*-Bioeinheit 6,6—9,2 und *Salix alba*-Bioeinheit 5,2—9,3). Dass sie sich auf gleichem Überschwemmungsniveau unter gleichartigen ökologischen Verhältnissen ausbilden und eigentlich die Strauchweidenvegetation das kurzzeitige einleitende Stadium des Weiden-Pappel-Auenwaldes darstellt. Diese starke ökologische Überschneidung führte in der Vergangenheit dazu, dass die (entsprechenden) Zönosen der *Salix triandra*- und der *Salix alba*-Bioeinheit zur gleichen Assoziation gestellt wurden (SIMON, TIMÁR, usw.).

Die Schilf-Bioeinheiten zeigen W-Zahlen zwischen 9 und 10. Davon weichen die längere Zeit in Wasser stehenden Bestände ab, in denen, Synusien bildend, Wassermakrophyten in manchmal bedeutenderen Mengen auftreten. Die W-Zahl solcher Bestände zeigt ähnlich jener der Laichkräuter Werte zwischen 10,5 und 10,8. Die W-Zahlen der Makrophyten Bioeinheiten liegen zwischen 10 und 11. Die W-Zahl einzelner Bestände kann sich auch auf den von 9—10 erstrecken. Es sind diese in erster Linie in zeitweilig mit Wasser bedeckten Windungen, in verflachenden toten Armen ausgebildete Laichkrautbestände, von denen das Wasser abfallen kann. In ihren Beständen siedeln sich mit unterschiedlicher Bedeutung Sumpfarten (*Phragmites communis*, *Schoenoplectus lecustris*, *Typha* usw.) an.

Die Analyse der Zönose aufgrund der W-Zahl kann in bezug auf die Standortverhältnisse der in Überschwemmungsgebieten ausgebildeten Bioeinheiten nützliche Informationen geben. Das betrifft in erster Linie die Dauer der Überflutung und die Grundwasserverhältnisse. Sehr nützliche Informationen gewinnen wir auch auf der Grundlage des Vergleichs der primären Auenwälder und der nach dem Kahlschlag sich ausbildenden Sumpf- bzw. Mähwiesen.

Das Verhalten der Indikatorzahlen im WR-Koordinatensystem in verschiedenen Gesellschaften

Aufgrund der Analyse der Werte im WR-Koordinatensystem kann festgestellt werden, dass sich die Amplitude der Makrophytenbioeinheiten der Überschwemmungsgebiete und der Gewässer in Ungarn in ziemlich engen Grenzen bewegt (Rx 3,3 und 4,3).

Zur Information sind hier die Rx-Amplituden einiger untersuchten Bioeinheiten zusammengeställt (Abb. 1—4):

Bioeinheit	Rx Amplitude
Salix triandra Bioeinheit	3.4—3.9 (4.7)
Salix alba Bioeinheit	3.3—3.9
Fraxinus pannonica-Ulmus Bioeinheit	3.3—3.9
Phragmites communis Bioeinheit	4.0—4.5
Typha Bioeinheit	3.6—4.1
Phragmites-Carex Bioeinheit	3.4—4.1
Potemogeton perfoliatus Bioeinheit	3.5—4.5
Nymphaea alba Bioeinheit	2.5—3.3
Trapa natans Bioeinheit	4.0—4.5
Lemna Bioeinheit	4.0—4.5

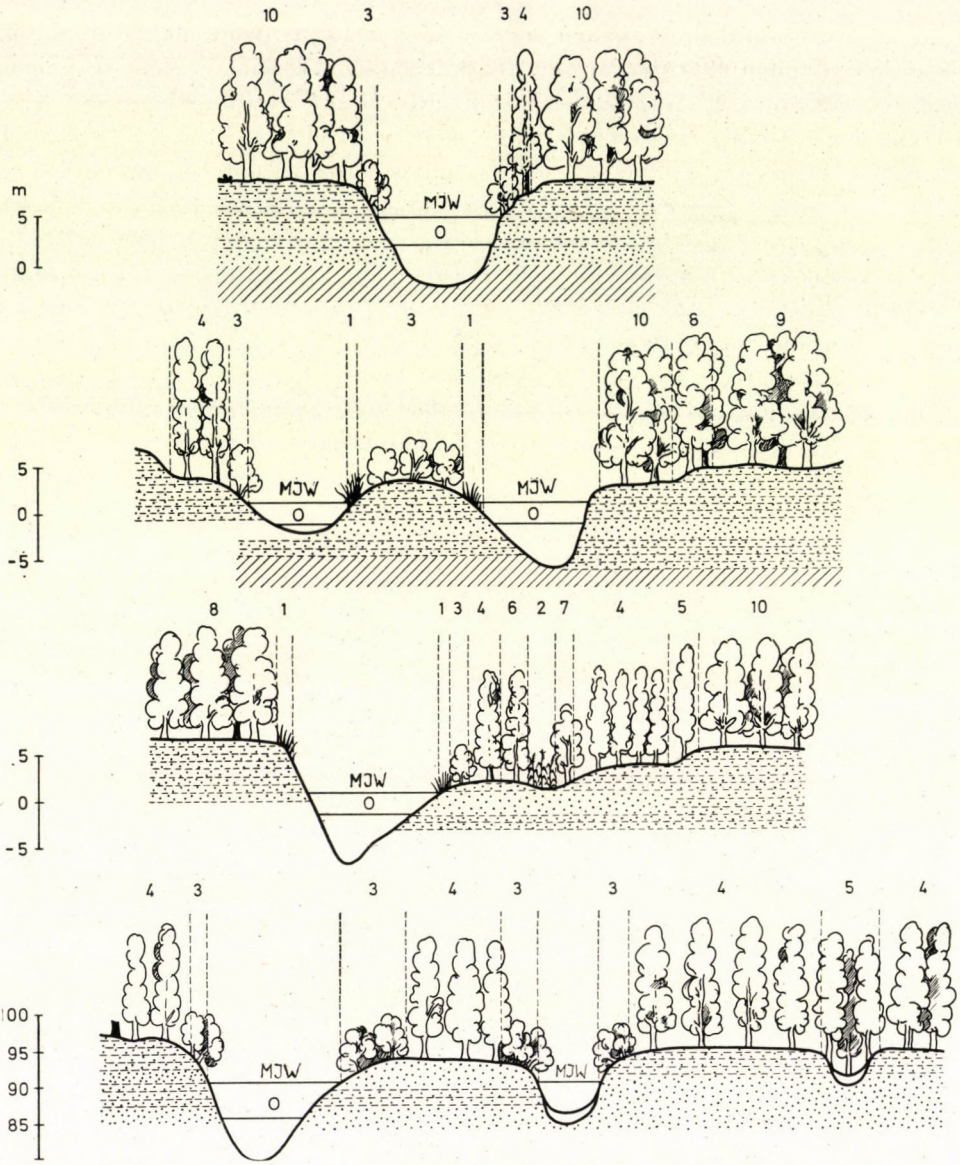

Abb. 4. Haupttypen der Inundationsniveaus entlang des Hauptarmes der Donau in der grossen ungarischen Tiefebene. Von ISTVÁN KÁRPÁTI und MÁRTON PÉCSI. a — Hauptarm mit nahezu symmetrischem Ufer, b— durch unechten Flussarm gegliederter Inundationstypus, c — Inundationsniveaus der sich verschiebenden Flussbettmeander, d — Inundationsniveaus der Donau bei der Schiffslände von Kalocsa; II — Zwergbinsengesellschaften (*Nanocyperion*), III — Teichröhricht (*Scirpto—Phragmitetum*), 10 — Weidenbüsche am Ufer (*Salicetum triandrae*), 11 — Weiden—Pappel—Au (*Salicetum albae — fragilis*) 11c, — Weiden—Pappel—Au-Subassoziation mit Sumpfriedgras (*caricetosum acutiformis*), 11b — Weiden—Pappel—Au-Subassoziation mit weissem Straussgras (*agrostetosum*), 12 — Eichen—Ulmen—Au, 12a — Subassoziation vom Typus Eichen—Ulmen—Au (normale), 12b — Eichen—Ulmen—Au-Subassoziation mit Waldmeister (*asperuletosum*), 12c — Eichen—Ulmen—Au-Subassoziation mit Maiglöckchen (*convallarietosum*).

Die Indikatorzahlen zeigen nahezu chemisch neutrale Reaktionen an und unterstreichen eher das Gewicht kalkliebender Arten. Das steht in Übereinstimmung mit den Aziditätsverhältnissen in den Überschwemmungsgebieten und Gewässern Ungarns.

Die Verwendung des Zeigerwertes der entscheidenden ökologischen Faktoren (Wärme, Wasserhaushalt, chemische Reaktion) in bezug auf Bioeinheiten bzw. Cönosen kann, wie wir am Beispiel der Wasser- und Überschwemmungs-Bioeinheiten zeigten, für synokologische Forschungen ausserordentlich nützliche Informationen geben. Die gewonnenen Daten stellen auch Anhaltspunkte für die Praxis der Wasserwirtschaft dar. Wir berücksichtigen die Ergebnisse in unseren Forschungen und wollen die diesbezüglichen Untersuchungen auch in Zukunft fortsetzen.

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BODENINDIKATION DER DOMINANTEN PFLANZEN VON KONTAKTGESELLSCHAFTEN IN DEN WIESENGESELLSCHAFTEN

Von

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The author treats the problems of soil conditions of *Juncteum subnodulosi* and of the grassland associations in contact with it, and those of soil indication by plants constituting the stand.

Einleitung

Eines der Ziele der kausalen Vegetationsforschung ist die Klarlegung jener ursächlichen Zusammenhänge, die zwischen bestimmten ökologischen Faktoren und Pflanzengesellschaften bzw. Pflanzenarten bestehen. Zur Kenntnis der synökologischen Verhältnisse sowie zur Untermauerung ihrer floristischen Differenzierung ist es wichtig, die Standortfaktoren sowohl qualitativ als auch quantitativ zu bestimmen. Der Boden bildet eine der Erklärungen dafür dass in einem gegebenen Gebiet unter gleichen klimatischen, physiographischen usw. Verhältnissen verschiedene Pflanzengesellschaften (Vegetationseinheiten) räumlich nebeneinander in bestimmter floristischer Zusammensetzung vorkommen.

Die indikative Wertung der Wiesenpflanzen bezieht sich in erstem Sinne auf die Temperatur-, Bodenfeuchtigkeits- und Reaktionsfaktoren, auf jene Faktoren also, die in erster Linie aufgrund der Verbreitung der Vegetation und ihrer zönologischen Verhältnisse bestimmt werden können. Verhältnismässig schwerer ist es, die Nährstoffindikation der Pflanzengesellschaften und Pflanzenarten zu bestimmen, da hier die effektiven Daten der Bodenuntersuchung nicht entbehrt werden können.

Aus der Reihe der zahlreichen Studien über der Indikationswerte der Wiesenpflanzen seien hier — ohne Auspruch auf Vollständigkeit — nur einige genannt: ELLENBERG (1952, 1963), MEYER (1957), DANCAU und LUTZ (1958), ZÓLYOMI und PRÉCSÉNYI (1964), ZÓLYOMI et al. (1967), SOÓ (1964—73), HUNDT (1966 a, b), ALMÁDI (1972) usw.

Die Bestimmung der Bodenindikation der Wiesenpflanzen und Pflanzengesellschaften ist wesentlich problematischer als die der Pflanzenarten der Wälder:

a. Die schon seit Jahrhunderten unter Kultur stehenden Wiesen werden infolge der konstanten Kultivierungsmethoden (regelmässiges Mähen, mögliche Beweidung der Nachmahd, mögliche Düngung usw.) gewissermassen homogenisiert.

b. Im Heu verlassen alljährlich jene Minerale das Gebiet, die sich je nach der Arteigenheit der die Wiesen bildenden Arten in den Pflanzen anhäufen; die biologische Nährstoffzirkulation bricht ab und der Boden verarmt allmählich an bestimmten Mineralen (vgl. Kovács 1973). Eine Ausnahme bilden die sogenannte »Streu«-Wiesen (Gross-seggen- und Moorwiesen-Gesellschaften), auf denen das Heu wegen seiner Minderwertigkeit liegenbleibt, so dass die angehäuften Minerale kehren fast in den Boden zurück.

Unsere Forschungen setzten sich das Ziel, aufgrund von Bodenuntersuchungen die Parallelen zwischen den floristischen und den Boden-Differenzierung zu bestimmen und die Bodenindikation der miteinander in Kontakt stehenden Wiesengesellschaften auszuwerten.

Forschungsobjekte

Die Forschungsobjekte waren die in verschiedenen Gebieten von Transdanubien (Tapolca, Nemesvita, Várvölgy, Türje, Sárhida) auf Wiesen-moorböden und sumpfigen Wiesenböden vorkommenden *Juncetum subnodulosi*-Bestände und deren Kontaktgesellschaften (*Caricetum gracilis*, *Szeslerietum uliginosae*, *Szesleria uliginosa*-,*Carex-davalliana*-, *Molinia coerulea*-Komplex *Molinietum coeruleae*) stehen im floristischen und sukzessiven Verhältnis mit den binsenbewachsenen Moorwiesen (*Juncetum subnodulosi*). Wegen der Geländeverhältnisse kann das *Juncetum subnodulosi* auch mit dem in floristischer Hinsicht distanzierten *Arrhenatheretum elatioris* (als Mähwiese) in Kontakt stehen.

Der *Juncus subnodulosus* bildet wegen seiner unterirdischen Ausläufen auf kalkreichen, neutralen und basischen Wiesenmoorböden und sumpfigen Wiesenböden Bestände charakteristischer Physiognomie (vgl. Kovács 1962).

Der *Juncetum subnodulosi* und seine Kontaktgesellschaften (mit Ausnahme des *Arrhenatheretum*) sind den Kultureinflüssen vom Mähen abgesehen, weniger ausgesetzt (z. B. der Düngung). In manchen Gegenden entfällt wegen der minderen Heuqualität auch das Mähen.

Untersuchungsmethode

Nach der Methode der transekten Probeentnahme wurden an den Grenzen der Kontaktgesellschaften entlang in einer geraden Linie, in Abständen von je 2 m j 10 Bodenproben genommen. Die Laboruntersuchungen der Proben führten wir nach der Methode von Ballenegger—Di Gléria (1962) durch. (Hier sei erwähnt, dass die Zahl der adsorbierten Kationen wegen des hohen Kalkgehaltes der untersuchten Böden eine Unvollkommenheit der Mehlichschen Methode, — höher ist als die Adsorptionskapazität — vgl. Ballenegger—Di Gléria 1962.)

Gleichzeitig mit den Bodenproben wurden auch Heuproben entnommen. Die Untersuchung des Mineralgehaltes haben wir nach der Methode von Frau Hámory-Szabó (1959) durchgeführt.

Die Übereinstimmung der floristischen Zusammensetzung der Kontaktgesellschaften bestimmten wir mit Hilfe des Ähnlichkeitskoeffizienten (Ellenberg 1956). Die statistische Wertung der Bodenfaktoren wurde mit dem t-Test (nach Sváb 1967) vorgenommen.

Untersuchungsergebnisse

Aufgrund der Bodenuntersuchungen und der statistischen Auswertungen (Tabellen 1 und 2) lässt sich eine auch quantitativ messbare signifikante Differenz bei den Probeflächen der auf Böden gleichen Typs vorkommenden Kontaktgesellschaften (Beständen) von *Juncetum subnodulosi* und *Caricetum gracilis* (bzw. deren in Moorwiesen übergehendem Bestand) hinsichtlich 5—7 Bodenfaktoren feststellen.

Tabelle 1

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Tapolca, Vergleichstabelle ihrer Signifikanz

Caricetum gracilis		*Juncetum subnodulosi*	
Moorboden			
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	68.70	70.20	NS
Sandfraktion	8.22	10.85	+++
hy (Hygroskopizität)	5.84	6.08	NS
pH im Wasser	7.59	7.61	NS
$CaCO_3$ %	49.00	37.40	NS
Humus %	21.47	21.42	NS
Q (Humusstabilitätszahl)	2.107	1.602	NS
N %	1.248	1.270	NS
NH_3-N mg/100 g	1.21	0.52	+
NO_3-N mg/100 g	11.71	14.00	(+)
K_2O mg/100 g	7.61	8.52	NS
P_2O_5 mg/100 g	0.76	0.85	+
Ca-mval./100 g	76.43	84.31	+
S-mval./100 g	88.54	97.42	++
T-mval./100 g	61.40	73.63	+++
V %	100	100	

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
(+): Differenz an der 10% igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+: Differenz an der 5%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.

Auf der Probefläche von Tapolca (Tabelle 1), wo auf Torf mit stark zersetztem Oberschicht *Juncetum subnodulosi*- und *Caricetum gracilis*-Bestände antreffen und weist der Boden eine signifikante Differenz im Gehalt an Ammoniak, Nitraten und Phosphor sowie in der Menge der Sandfraktion und in der Zahl der austauschbaren Kationen auf.

Bei den auf sumpfigen Wiesenböden wachsenden Beständen (Türje, Tabelle 2) bestehen signifikanten Unterschiede im Phosphor- und Kali-Gehalt, in der Humusqualität sowie in der Menge der Sandfraktion und im hygroskopischen Wert.

Tabelle 2

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Türje (2), *Vergleichstabelle ihrer Signifikanz*

Caricetum gracilis Übergangsbestand zu den Moorwiesen		*Juncetum subnodulosi*	
Sumpfiger Wiesenboden			
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	73.43	73.31	NS
Sandfraktion	7.90	6.64	+
hy (Hygroskopizität)	3.35	3.64	+
pH im Wasser	7.25	7.32	NS
$CaCO_3$ %	3.35	3.64	NS
Humus %	9.46	9.48	NS
Q (Humusstabilitätszahl)	3.095	3.699	+++
N %	0.529	0.557	NS
NH_3-N mg/100 g	0.48	0.52	NS
NO_3-N mg/100 g	3.09	2.72	NS
K_2O mg/100 g	4.60	5.44	++
P_2O_5 mg/100 g	1.56	1.12	++
Ca-mval./100 g	41.92	45.51	NS
S-mval./100 g	47.36	50.90	NS
T-mval./100 g	27.93	29.12	NS
V %	100	100	NS

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
+: Differenz an der 5%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle, zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle, zwischen den beiden Mittelwerten.

Aufgrund der floristischen Zusammensetzung schreibt sich der Ähnlichkeitskoeffizient der *Caricetum gracilis*- und der *Juncetum subnodulosi*-Bestände zu 41,3—48,7%. Die verhältnissmässig grosse floristische Ähnlichkeit der Kontaktgesellschaften ergibt sich aus den identischen Bodentypen, aus der Tatsache, dass Differenzen bei verhältnissmässig wenigen Bodenfaktoren bestehen und aus den Sukzessionsverhältnissen (das *Caricetum gracilis* kann eine Initialgesellschaft für das *Juncetum subnodulosi* bilden).

Bei den zur gleichen Assoziationsgruppe (*Caricion davallianae*) gehörenden Kontaktgesellschaften (*Juncetum subnodulosi*, *Seslerietum uliginosae*, Nemes-

Tabelle 3

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Nemesvita (1), *Vergleichstabelle ihrer Signifikanz*

Seslerietum uliginosae		*Juncetum subnodulosi*	
Sumpfiger Wiesenboden			
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	70.50	70.65	NS
Sandfraktion	4.71	4.41	NS
hy (Hygroskopizität)	2.27	2.26	NS
pH im Wasser	7.29	7.77	NS
$CaCO_3$ %	24.00	22.85	NS
Humus %	8.25	6.76	+++
Q (Humusstabilitätszahl)	1.224	1.033	++
N %	0.505	0.439	+++
NH_3-N mg/100 g	0.22	0.25	NS
NO_3-N mg/100 g	1.61	1.70	NS
K_2O mg/100/g	7.88	7.40	NS
P_2O_5 mg/100 g	2.43	2.05	++
Ca-mval./100 g	35.16	33.11	NS
S-mval./100 g	48.14	43.64	NS
T-mval/100 g	27.38	25.83	NS
V %	100	100	NS

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.

vita 1, Tabelle 3) errechnet sich die floristische Übereinstimmung 54,8%, und der Boden der beiden Bestände zeigt in vier Faktoren eine signifikante Differenz im Phosphor-, im gesamten Stickstoff- und im Humus-Gehalt sowie in der Qualität des Humus.

Das *Juncetum subnodulosi* (Nemesvita 2, Tabelle 4) hat in seinem Kontakt mit den an die austrocknenden Moorwiesen angenäherten Beständen (*Sesleria uliginosa-*, *Carex davalliana-* und *Molinia coerulea* Komplex) eine floristische Ähnlichkeit von 47%. Auch bei gleichen Bodentypen können sich jene Bodenfaktoren (Grösse der Sandfraktion, Kalk-, Humus-, gesamter Stickstoff-, Ammoniak-, Kali- und Phosphor-Gehalt) vermehren bei welchen eine signifikante Differenz zwischen den beiden Beständen besteht.

Parallel mir der Änderung der Sukzessionsverhältnisse erhöht sich die Zahl jener Bodenfaktoren, bei denen eine signifikante Differenz besteht.

Die floristische Ähnlichkeit des *Junceteum subnodulosi* mit der mit ihm in Kontakt stehenden und bereits einer anderen Assoziationsgruppe (*Molinion*

Tabelle 4

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Nemesvita (**2**), *Vergleichstabelle ihrer Signifikanz*

Sesleria uliginosa-Carex davalliana-Molinia coerulea-Komplex		*Juncetum subnodulosi*	
Sumpfiger Wiesenboden			
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	67.49	68.96	NS
Sandfraktion	3.45	2.34	+
hy (Hygroskopizität)	2.48	2.58	NS
pH im Wasser	7.69	7.50	NS
$CaCO_3$ %	19.04	21.40	+
Humus	8.00	6.98	+
Q (Humusstabilitätszahl)	0.561	0.435	NS
N %	0.494	0.442	++
NH_3-N mg/100 g	0.42	0.10	+++
NO_3-N mg/100 g	1.47	0.98	NS
K_2O mg/100 g	10.03	8.47	++
P_2O_5 mg/100 g	1.80	1.47	(+)
Ca-mval./100 g	34.36	31.59	NS
S-mval./100 g	47.34	43.47	NS
T-mval./100 g	26.64	25.54	NS
V %	100	100	NS

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
(+): Differenz an der 10%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+: Differenz an der 5%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.

coeruleae) angehörenden im Austrocknen begriffenen Moorwiese (*Molinietum coeruleae*) errechnet sich immer noch zu 45% (Várvölgy, Tabelle 5). Sukzessionsmässig kann man das *Molinietum coeruleae* als ein Endstadium des *Juncetum subnodulosi* auffassen. Diese beiden Bestände zeigen bereits in 10 Faktoren eine signifikante quantitative Differenz.

Sukzessionsmässig ist die Beziehung zwischen dem *Juncetum subnodulosi* und dem *Arrhenatheretum* bereits gering, aufgrund der Geländerverhältnisse entsteht aber trotzdem oft ein direkter Kontakt (Sárhida, Tabelle 6). Wegen der bedeutenden floristischen Differenzierung besteht aber nur noch ein Ähnlichkeits-Koeffizient von 14%. Die Bestände kommen bereits auf Böden verschiedenen Typs vor (auf sumpfigen Wiesenböden und auf Wiesenböden). Eine signifikante Differenz ist bereits bei 14 Bodenfaktoren nachweisbar.

Tabelle 5

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Várvölgy, Vergleichstabelle ihrer Signifikanz

Molinietum caricetosum		*Juncetum subnodulosi*	
Sumpfiger Wiesenboden			
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	62.79	58.13	+++
Sandfraktion	16.09	20.53	++
hy (Hygroskopizität)	4.26	6.58	+++
pH im Wasser	7.69	7.76	NS
$CaCO_3$ %	54.80	31.41	+++
Humus	12.98	18.44	+++
Q (Humusstabilitätszahl)	0.779	0.985	+
N %	0.78	0.95	+++
NH_3-N mg/100 g	1.44	1.81	NS
NO_3-N mg/100 g	1.56	1.64	NS
K_2O mg/100 g	8.27	27.58	+++
P_2O_5 mg/100 g	3.60	2.71	+++
Ca-mcal./100 g	41.90	58.55	+++
S-mval./100 g	52.48	72.30	++
T-mval./100 g	70.00	86.28	+++
T-S-mval./100 g	17.51	13.38	++
V%	74.89	84.25	++

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
+: Differenz an der 5%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.

Bei mehreren Transektuntersuchungen besteht eine signifikante Differenz im leicht aufnehmbaren K_2O-Gehalt des Bodens. Diese Differenz ist bei den Kontaktgesellschaften des Várvölgy (vgl. Tabelle 5.) besonders hoch. Auf diesem Gebiet werden die Moorwiesen nicht gemäht, das Produkt bleibt an Ort und Stelle und die Minerale gelangen nach ihrem Abbau in den Boden zurück. Nach den Ergebnissen der chemischen Analyse (Tabelle 7) häuft sich in den Heuproben des *Juncetum subnodulosi* (wo das Heu zu 80—90% aus *Juncus subnodulosus* besteht) im grossen Mengen Kali an. Aufgrund des Tests besteht an der 10% igen Signifikanzschwelle eine signifikante Differenz im Kaligehalt des Heuproben aus den Beständen des *Juncetum subnodulosi* und jener aus dem untersuchten Kontaktgesellschaften. (Der *Juncus subnodulosus* ist als kalkliebend bekannt: in seinem Heu häuft sich allerdings im allgemeinen sowenig oder ebensoviel Kalk an wie in dem der Kontaktgesellschaften.)

Tabelle 6

Mittelwerte der Bodenfaktoren von Wiesengesellschaften bei Sárhida, Vergleichstabelle ihrer Signifikanz

Arrhenatheretum elatioris Wiesenboden		*Juncetum subnodulosi* Moorwiesenboden	
n = 10	$\bar{x}$	n = 10	$\bar{x}$
Abschlämmbarer Teil	70.02	64.76	+++
Sandfraktion	9.20	10.60	NS
hy (Hygroskopizität)	2.05	5.50	+++
pH im Wasser	7.25	7.42	NS
$CaCO_3$ %	4.69	7.38	+++
Humus %	5.81	14.70	+++
Q (Humusstabilitätszahl)	2.538	1.556	++
N %	0.341	0.808	+++
NH_3-N mg/100 g	0.40	0.49	++
NO_3-N mg/100 g	1.06	6.87	+++
P_2O_5 mg/100 g	10.10	0.57	+++
K_2O mg/100 g	4.05	5.09	+++
Ca-mval./100 g	27.71	69.61	+++
S-mval./100 g	32.22	83.59	+++
T-mval./190 g	22.43	68.74	+++
V %	100	100	

NS: Keine Signifikanz in der Differenz zwischen den beiden Mittelwerten.
++: Differenz an der 1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.
+++: Differenz an der 0.1%igen Signifikanzschwelle zwischen den beiden Mittelwerten.

Wo die Bestände des *Juncetum subnodulosi* regelmässig gemäht werden, verringert sich allmählich der Gehalt des Bodens an leicht aufnehmbarem Kali (z. B. Nemesvita 2, Tabelle 4).

Zusammenfassung

Zwischen den floristisch und zönologisch verwandten, miteinander in Kontakt stehenden, auf Böden gleichen Typs wachsenden Beständen der Wiesengesellschaften besteht in allen Fällen hinsichtlich mehrerer untersuchter Bodenfaktoren eine quantitative, bzw. signifikante Differenz. Die floristische Differenz wird in allen Fällen durch die Bodendifferenz untermauert.

Je grösser die floristische Ähnlichkeit zwischen Kontaktgesellschaften ist, um so geringer ist die Zahl der Bodenfaktoren, in denen sich eine signifikante Differenz zeigt.

Tabelle 7

Asche- und Mineralstoff-Gehalt in Prozenten der Trockensubstanz von Heuproben der Wiesenböden

Nr.	Name der Gesellschaft (Muster)	Fundort	Asche %	SiO_2 %	Ca %	K %	Na %
1.	*Caricetum davallianae*	Türje 2.	8.05	0.22	0.41	0.42	0.016
2.	*Juncetum subnodulosi*	Türje 2.	5.18	0.39	0.18	0.80	0.24
3.	*Caricetum gracilis*	Tapolca a,	5.92	0.22	0.25	0.20	0.024
4.	*Juncetum subnodulosi*	Tapolca a,	7.10	0.53	0.28	0.50	0.36
5.	*Caricetum gracilis*	Tapolca b,	6.89	0.26	0.28	0.21	0.028
6.	*Juncetum subnodulosi* 1.	Tapolca b,	6.13	0.19	0.20	0.47	0.34
7.	*Juncetum subnodulosi* 2.	Tapolca b,	5.64	0.30	0.15	0.50	0.33
8.	*Seslerietum uliginosae*	Nemesvita 1.	6.05	0.26	0.21	0.29	0.011
9.	*Juncetum subnodulosi*	Nemesvita 1.	4.48	0.22	0.15	0.61	0.21
10.	*Sesleria u.-Carex d.-Molinia c.* komplex	Nemesvita 2.	5.43	0.21	0.22	0.28	0.011
11.	*Juncetum subnodulosi*	Nemesvita 2.	5.14	0.20	0.13	0.60	0.097
12.	*Arrhenatheretum*	Sárhida 1.	7.47	—	0.21	0.94	0.060
13.	*Juncetum subnodulosi*	Sárhida 1.	9.51	—	0.53	1.33	0.14

Parallel mit der floristischen Differenzierung (sukzessionelle Veränderung) erhöht sich die Zahl jener Faktoren, bei denen signifikante Differenzen gemessen werden können.

Die Bodendifferenzierung ist qualitativ und quantitativ — trotz des räumlichen Kontakts — bei den miteinander sukzessionell in lockerem Kontakt stehenden Gesellschaften die grösste. Parallel hierzu ist auch die floristische Differenzierung verhältnismässig gross. Artenspezifisch ist die Eigenheit, dass sich bestimmte Minerale in bestimmten Pflanzenarten stärker anhäufen. Je nach der Wiesenbewirtschaftung gelangen diese Minerale entweder in den Boden zurück (wenn die Wiesen nicht gemäht werden) wobei sie sich im Boden anhäufen oder das Heu wird von der Wiese fortgeschafft, und der Boden verarmt allmählich an dem betreffenden Mineral.

Die genannten Umstände erschweren die Bestimmung der Indikationswerte der einzelnen Elemente bzw. des Nährstoffgehaltes, auf die die Wiesenpflanzen der untersuchten Böden hindeuten.

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A NEW APPROACH TO THE FORMATION OF GENE CENTRES

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By linguistic attempts in earlier times, then by archeological and other methods, the place of origin and evolutionary process of cultivated plants were successfully clarified, VAVILOV used an approach centering on pre-matter. The gene centres assigned by him represented the probable regions of origin. They all lie in the zone delimited by 25A—35° N lat. Later the gene centres were extended to "macro-centres"

According to the author's conception VAVILOV's gene centres are to be considered the primordial sites of origin. The favourable geographical articulation, including plateaus at 1000—3000 m heights, was advantageous for the development of VAVILOV's gene centres. Heights above sea level moderated the influence or southern situations, allowing the development of cultivated plants, e.g. wheat, pea, lentil suitable also in more northern, temperate areas. The favourable geographical situation afforded both the "discovery" of plant cultivation and the husbandry suitable culture species.

Since the last century, several attempts were made to determine the place (the country) of origin of our cultivated plants. The first thought was to approach the places of origin on the basis of comparative linguistics, and the findings were soon compared with those of archeology. Concepts, however, were supported by more scientific fundamentals only when the problem was approached from the side of the pre-material.

On the basis of extensive researches, VAVILOV established about 50 years of the place of origin of the cultivated plants (the gene centres), and their geographical distribution. It is common knowledge that the principle in assigning the gene centre was that the variation of the culture species be the greatest there. Favourable oecological conditions unfolded a rich variety of forms, that is, increased the frequency of certain characteristics. That is why these places have been called "frequency centres" as well.

The geographical position of the gene centres

Let us have a look at the geographical position of the primary centres of origin ("main gene centres") determined by VAVILOV. As is known, they in their great majority fall into the subtropical zone, in the belt delimited by the 25°—35° northern parallels. Would this arrangement be merely coincidental? No attempt has been mode so far to explain this interesting fact.

Facts were simply accepted, and at best the importance of this geographical zone in primary gene centre formation was qualified merely as interesting.

Recently, naturally, the geographical boundaries of the so-called macro-centres have been expanded. LEPPIK (1969) described the enlarged "macro-centres" (Fig. 1). on the basis of ZHUKOVSKYS original map. These spread

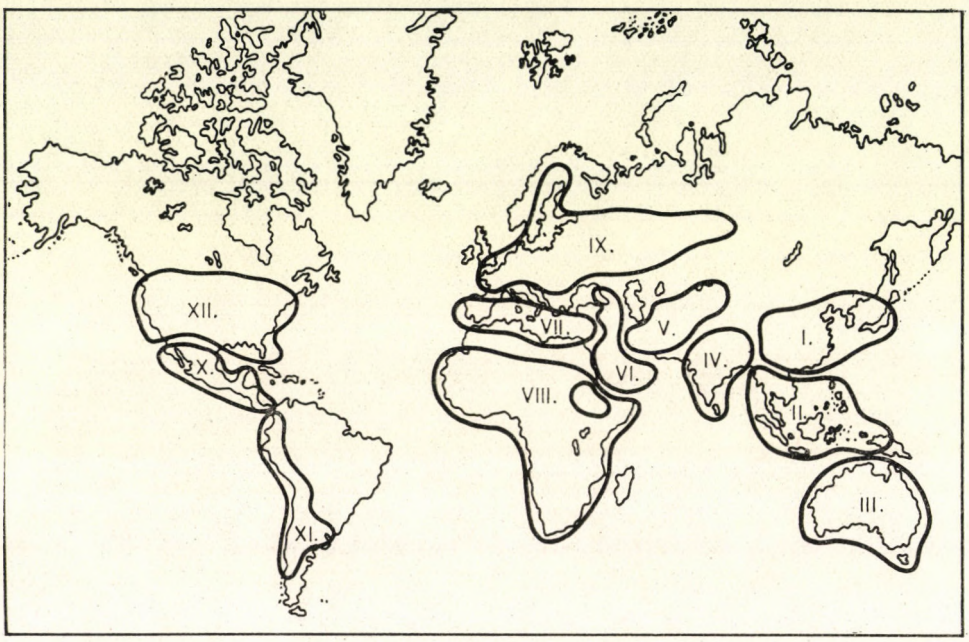

Fig. 1. The macro-centres of cultivated plants as determined by VAVILOV and ZHUKOVSKY (ZHUKOVSKY's map. I. Chinese-Japanese, II. Indonesian-Indochinese, III. Australian, N. Indostanean, V. Central Asian, VI. Near-Eastern, VII. Mediterranean, VIII. African, including Ethiopia, IX. Euro-Sibirian, X. Central American.) After Leppik

from the original VAVILOV-type zone far towards the north and south, but the original subtropical zone still stands out well also on this map, which is most important from the view of the origin of the very culture plants of the temperate zone. The extension of the gene centres into macro-centres was a natural process. This had taken place during later periods, after man developed his first cultivated plants on his primitive fields and the "art" of vegetable growing spread all over the world. The original state of affairs is therefore reflected by VAVILOV's conception. It would be only the obfuscation of the evolutionary development, if VAVILOV were accused of "inaccuracy" or of "largeness". The greatness of VAVILOV's conception lies in the very fact that he recognized the initial state of circumstances.

Corroborations of Vavilov's original conception

First the events of geohistory that followed the ending of the latest glacial period should briefly be treated. In the Würm glacial the tundra belt extended down to North Lat. 45°, followed by the forest belts of the temperate zone down to N. Lat. 36°. Naturally, prehistoric man was also forced to migrate southwards, and this settled also in the belt of temperate zone forests, which already fell in the area of the "Mediterranean" climatic zone. A disadvantage of this belt were if it would be warmer and drier than desired, had this been moderated by the advantageous geographical situation with its high plateaus. Both in Eurasia and America plateaus 1000—3000 m a.s.l. alleviated the disadvantages of the geographical situation, and secured conditions as were available later in the more northern areas of the temperate zones. Thus it was possible here to cultivate plants which could exist equally well under the conditions of the temperate zones and after the withdrawal of glaciation, more northern arable fields could also be vanquished.

Today it is generally agreed that the discovery of the "art" of plant growing can referred to this same area. Excavations conducted in the Jarmo region have especially shown that the high altitude areas between the Caucasus and the Zagros Mountains, were the regions man discovered the admirable "art" of plant growing. It was from this area that the magnificent "know-how" spread toward the west and the east, but also northwards and southwards, following the spread of the "neolithic wave". All these happened parallel with the gradual passing-away or retreat towards the north of the glacial. Man not only recaptured the "old lands" but also carried with himself the know-how of plant growing, and also the developed cultivated plants. A similar process had taken place in America, but information in this regard is still meagre.

The gratness of VAVILOV's original conception thus reflects the beginning of development while the later situation, the final state of development is described on the basis of the "macro-centres". Therefore the problem of gene centres should be posed not in relation to the final state, the macro-centres but also the course of their development should be taken into consideration. The basis is the belt of gene centres assigned by VAVILOV, the zone wich at the same time was also the cradle of plant cultivation.

Summary

The gene centres determined by VAVILOV, have recently been expanded into macro-centres. This newer conception is correct only if the "phylogenesis" of the places of origin of the cultivated plants is also accepted. VAVILOV's conception determined the starting point of the development. It was this

basis from where macro-centres developed, that is, the discovery of the knowledge of plant cultivation provided the opportunity of spreading on a larger scale. The conception of macro-centres fixes the final state of development.

The possibility of development of the gene centres was given by the favourable geographical conditions. Glaciation advanceing southwards in the Würm period forced man into the subtropical zone, where 1000—3000 m high plateaus tempered the unfavourable climatic effects. This is the reason why the gene centres were located in the zone delimited by the northern parallel 25—35°. Because of the favourable conditions man was able to discover plant cultivation and could develop the first cultivated plants. Since the western part of the zone is seabound, in Eurasia, the places of development of the gene centres in the prehistoric world may hawe been the eastern regions characterized by plateaus.

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EFFECT OF CASEIN HYDROLYSATES ON THE GROWTH OF TOBACCO CALLUS TISSUES (NICOTIANA TABACUM L.)

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The author examined the effect of various preparations of casein hydrolysates (amparon, aminosol, aminofusin) on the growth of callus tissues of the stem of tobacco plant (*Nicotiana tabacum* L.). The isolated secondary cultures grew on modified GAUTHERET-(1959) and MURASHIGE–SKOOG-type (1962) solid nutrients in a dark thermostat, containing also hormonal inhibitors (IAA, 2, 4-D, Kinetin, GA, CM), at 28 $\pm$1°C, for four weeks. The rate of tissue growth was established from the increment in fresh weight and dry weight, and from the change in cell number. The daily and relative rates of increment were also calculated. The experimental data are the results of a statistical evaluation.

The data of the experiment show that, besides the primary regulators in the growth of the isolated tobacco callus tissue, that is, the hormonal regulators, the various casein hydrolysates play a secondary role, since they can increase or decrease the effect of the formers. Among the examined casein preparations, the stimulating effect of amparon and aminosol is more pronounced, that of the aminofusin is moderate (presumably traceable to its sorbitol content). The prevalence of the effect always depends on the basic nutrient medium or rather on the proportion of hormonal substances in it.

Introduction

In the growth regulation of the isolated plant cells and tissues, the components of the nutrients play an important part. The role of the mineral elements is rather well-known, and suitable data are available on the effect of vitamine as well. The role of hormonal substances effecting direct regulation (auxins, cytokinins, gibberellins), and of the inhibitors, retardants, and their interactions are, however, less known, despite the great deal of scattered data (GAUTHERET 1959, KOBLITZ 1972, LINSMAIER and SKOOG 1965, STREET 1969). The effect mechanisms of the supplements are even less known, especially if they are dosed into the nutrients together with components of a hormonal character. Casein hydrolysates (CH) of various origins and different composition also represent such a group of substances (HILDEBRANDT 1962, MURASHIGE and SKOOG 1962, STEWARD and SHANTZ 1956, STREET 1966, 1969).

We have therefore compared in this study the effects on tissue growth of preparations of some casein hydrolisates of different compositions that are known as the components of nutrients. Our aim was to attain, by a cytomorphological analysis of the effects, a nearer insight into the causes of cell- and tissue growth.

Material and method

Callus tissues isolated from the tobacco stem (*Nicotiana tabacum* L.) were used as plant test materials in our experiments. The tissue stock originated from a multiannual culture, exhibiting a uniform and intensive growth on its basic nutrient medium. The culture consists of a slightly differentiating cell population. The designations of the nutrient media are L,Z, A, because the basic nutrient media taken over from the literature have been supplemented. The basic nutrient medium, designated as L, contained 2,4-D (2,4-dichlorophenoxyacetic acid 6 mg/l), and coconut milk (CM, 100 ml/l); that designated as Z contained IAA (β-indole acetic acid 4 mg/l) and 2,4-D (6 mg/l); and that designated as A contained IAA (2 mg/l), kinetin (K 0.2 mg/l) and ½GA (gibberellic acid, 1 mg/l) as regulators. Partly the GAUTHERET-type (1959) macro- and the HOAGLAND-type "A—Z" micro element mixture (G + H), partly the MURASHIGE—SKOOG (1962) nutrient medium (M—S) were used as basic nutrient media, with identical vitamins (aneurin 1 mg/l, niacin 0.5 mg/l, pyridoxine 0.5 mg/l). The nutrient medium G + H contained in addition cysteine (10 mg/l) and glycine (2 mg/l), while M—S contained glycine (2 mg/l) and myo-inositol (100 mg/l). The ferric component was given in the form of Na_2Fe-EDTA (3 ml/l) to the nutrient medium solidified with agar (0.8%). Before autoclaving, pH was set at 5.7. The carbon source was 3% saccharose (MARÓTI 1969, 1970, 1971).

Among the casein hydrolysate preparations the tissue-growing effects of amparon, aminosol-glucose and aminofusin were compared. Amparon contained 5% protein hydrolysate and 10% saccharose (Organon, Oss. preparation), aminosol-glucose contained 3.3% dialysed casein hydrolysate and 5.0% glucose (Vitrum production, Stockholm), while aminofusin contained amino-acids (50 g/l), sorbitol (100 g/l) and a mixture of various vitamins (nicotinic-acid-amide, pyridoxine, myo-inositol, riboflavin, ascorbic acid, rutine sulphate-Na) (J. PFRIMMER & Co. Erlangen Pharmazeutische Werke production). The casein hydrolysate supplements were sterilized by autoclave together with the nutrient medium, in the usual way. The 200 mg tissue inocula grew on 50 ml nutrient medium, in ERLENMEYER-vessels (200 ml), in dark thermostat at 28 ± 1°C for four weeks. For checking growth, the fresh weight of the tissues and dry matter content were weighed, and the cells counted with the aid of a BÜRKER chamber. The daily growth was calculated — which is the ratio between the weight differences measured at the end and at the beginning of the incubation time and the number of days of the incubation — as well as the rate of relative growth, which is the ratio between weight increase during the incubation time and the initial weight (MARÓTI 1965, 1966). All data were obtained by measuring 5 parallels in four repetitions, that is, from 20 measurements. The data were also statistically evaluated (SNEDECOR 1956).

Results

In our experiments partly the effects of some known casein hydrolysates were compared, partly the tobacco tissue growth is demonstrated as a function of the concentration of two preparations. Since these substances in general appear only as supplements in the nutrient media, we indicated also the regulators in the basic nutrient media of the individual variants.

A part of the experimental results is given in Table 1. The variant L — in which 2.4-D and CM acted as stimulator, and amparon as supplementary induced a very intensive tissue growth. The weight of the tissue increased to more than 52 times of its initial measure during four weeks. This means a daily average weight increase above 375 mg, a very considerable increment. The number of cells found in the weight unit (43.6×10^5 cells/g) is also very great, as a result in general of the coconut milk content in the nutrient media. By applying IAA instead of CM in the same nutrient medium (Z_1), the weight increase is essentially smaller, no more than 62%, in comparison with the

Table I

Effect of various nutrient supplements on the weight increase of tobacco callus tissues (Nicotiana tabacum)

Designation of nutrients: L, Z, A; G + H: GAUTHERET's (1959) macro- and HOAGLAND's microelement; M—S: MURASHIGE–SKOOG's (1962) nutrient medium; IAA = β-indole acetic acid; 2.4-D = 2.4-dichloro-phenoxyacetic acid; K = kinetin, GA = gibberellic acid; CM = coconut milk; $\bar{x}$ = mean value; s = standard error of mean value.

Designation	Nutrient medium	Regulators				Supplement				Weight increase		Dry weight in the percentage of the fresh weight ($\bar{x} \pm s$)	Cell number 10^5/g ($\bar{x} \pm s$)
	Basic	IAA mg/l	2.4-D mg/l	K mg/l	GA mg/l	CM ml/l	Ampa-ron ml/l	Amino-sol ml/l	Amino-fusin ml/l	mg/day ($\bar{x} \pm s$)	Relative		
L	G+H	—	6	—	—	100	50	—	—	375.2 (±25)	52.5	7.6 (±2.1)	42.6 (±5)
Z_1	G+H	4	6	—	—	—	50	—	—	235.2 (±10)	32.9	6.5 (±2.1)	25.6 (±5)
Z_2	G+H	4	6	—	—	—	—	50	—	142.0 (±32)	19.9	5.0 (±0.6)	14.2 (±1)
Z_3	G+H	4	6	—	—	—	—	—	50	30.3 (±2)	4.5	8.0 (±0.8)	19.8 (±1)
Z_4	G+H_1	4	6	—	—	—	—	—	—	20.9 (±1)	3.3	8.6 (±1.2)	17.0 (±1)
A_1	M—S	2	—	0.2	1	—	50	—	—	107.0 (±4)	15.0	5.5 (±1.1)	13.5 (±4)
A_2	M—S	2	—	0.2	1	—	—	50	—	32.8 (±1)	5.0	9.9 (±0.6)	16.2 (±1.2)
A_3	M—S	2	—	0.2	1	—	—	—	50	14.5 (±3)	2.0	8.6 (±1.2)	10.5 (±0.8)
A_4	M—S	2	—	0.2	1	—	—	—	—	165.8 (±2)	23.2	8.1 (±1.1)	13.1 (±1.1)

former. The number of cells is essentially smaller (about 60%) in the weight unit of this variant, which means that the size of the cells, or at least their weight, have nearly doubled. On the two nutrient media containing the amparon supplement apparently the regulators regulate the weight increase and the variation in cell numbers. However, from the comparison of the variants Z it appears that besides the same regulators the casein hydrolysate supplements are also important factors in tissue growth. By taking the growth of tissues grown on amparon nutrient media (variant Z_1) as 100% (235.2 mg/day) the growth intensity in the aminosolous (Z_2) variant is only of 60% (142.0 mg), that of the aminofusinous is of 12% (30.3 mg) while in the variant without supplement (Z_4) it is only of 8% (20.9 mg). This is clearly seen from the data of relative growth (32.9 — 3.3), which indicate the multiplication of tissue and weight during the incubation time. Therefore these data partly show that the casein hydrolysate as a supplement to the nutrient media has a part to play — beside the hormonal regulators — in tissue growth, partly they indicate that the various preparations also cause a considerable deviation. On the basis of changes in the number of cells it can be inferred that aminosol effects also the elongated growth of cells, since the cell number related to the unit weight (14.2×10^5 cells/g) is the smallest in this variant (Z_2) hence the tissue increment consists of cells with relatively greater weight, confirmed also by the percentage index of the dry weight (5%), indicating that the cells contain the greatest quantity of water in this variant.

In the nutrient media A, the stimulators were IAA, K and GA. The most intensive tissue growth occurred with variant A_4 without supplement. This suggests that for the division of cells the composition and proportion of the regulators in this series are much more favourable than in the series Z, where the variant without supplement caused the smallest growth intensity. The sequence of effectivity of the supplements was identical with that obtained in the previous (Z) series. Amparon was the most stimulatory, and aminofusin the least so. The results of this (A) series compared with those of the former (Z) suggest that the essential regulator in the growth of the callus tissue is the composition of the hormonal substances, but this effect can be either increased (variants Z) or decreased (variants A) by the casein hydrolysate supplements, so these may appear as secondary regulators.

In the second part of our experiments, the effect of the various concentrations of aminosol and aminofusin on the callus tissue growth was examined in two different nutrient media (Tables 2 and 3). In the nutrient medium containing IAA and 2.4-D (variants Z) aminosol stimulated tissue growth in each concentration. Even the smallest concentration (25 ml/l) caused a sixfold increase in tissue growth compared to that in the nutrient medium without supplement. The increase in concentration caused the growth intensity to be even higher. On the other hand, in the nutrient media (A) containing IAA,

Table II

Effect of the various concentrations of the aminosol nutrient supplement on the weight increase of tobacco callus tissues (Nicotiana tabacum)

(For symbols see Table I)

Designation	Nutrient medium	Supplement ml/l	Weight increase		Dry weight in the percentage of the fresh weight ($\bar{x} \pm s$)	Cell number 10^5/g ($\bar{x} \pm s$)
			mg/day ($\bar{x} \pm s$)	relative		
Z	G+H	—	20.9 (±1)	3.3	8.6 (±1.2)	17.0 (±1.0)
		25	132.0 (±18)	18.4	5.6 (±0.4)	24.4 (±1.7)
		50	142.0 (±32)	19.9	5.0 (±0.6)	14.2 (±1.0)
		100	151.0 (±51)	21.4	5.3 (±0.7)	21.8 (±1.9)
A	M−S	—	165.8 (±2)	23.2	8.1 (±1.1)	13.1 (±1.1)
		25	34.4 (±2)	5.4	8.3 (±0.5)	13.9 (±0.9)
		50	32.8 (±1)	5.0	9.9 (±0.6)	16.2 (±1.2)
		100	14.4 (±0.8)	2.3	9.9 (±0.3)	14.8 (±0.9)

Table III

Effect of the various concentrations of aminofusin nutrient supplement on the changes in weight of tobacco callus tissues (Nicotiana tabacum)

(For symbols see Table I)

Designation	Nutrient medium	Supplement ml/l	Weight increase		Dry weight in the percentage of the fresh weight ($\bar{x} \pm s$)	Cell number 10^5/g ($\bar{x} \pm s$)
			mg/day ($\bar{x} \pm s$)	relative		
Z	G+H	—	20.9 (±1)	3.3	8.6 (±0.8)	17.0 (±1.0)
		25	35.9 (±2)	5.6	7.2 (±2)	19.8 (±1.5)
		50	30.3 (±2)	4.5	8.0 (±0.8)	19.8 (±1.2)
		100	1.5 (±0.1)	0.2	7.7 (±1)	17.2 (±2.4)
A	M−S	—	165.8 (±2)	23.2	8.1 (±1.1)	13.1 (±1.1)
		25	71.0 (±2)	9.9	6.3 (±0.8)	12.9 (±0.8)
		50	14.5 (±3)	2.0	8.6 (±1.1)	10.5 (±0.8)
		100	4.6 (±0.2)	0.6	10.6 (±0.6)	15.7 (±0.8)

K and GA, the trend was the reverse. Each of the concentrations caused inhibition, which was 80% with the lowest (25 mg/l) concentration and 91% with the highest (100 mg/l) concentration. The number of cells per weight unit on this nutrient medium (A) was smaller in each concentration than in the series Z, so the cells were in general larger confirmed also by the data on percentage dry weight. Cell number and dry weight relations show a

similar trend also in the aminofusin series, its cause to be found rather in the stimulators than in the supplements.

Aminofusin shows a stimulating effect in a nutrient medium containing IAA and 2.4-D (series Z), but this does not reach the effect of aminosol, and the growth intensity is not parallel with the increase in concentration. Furthermore, at 100 mg/l concentration a definite inhibition occurs. The situation is in essence similar also in the other series (variants A). Therefore weight increase in callus tissue is rather inhibited than stimulated by aminofusin. The prevalence, however, of the effect is a function of the basic nutrient medium and of the hormonal regulators present in it.

Discussion

In the course of interpretation of the experimental data the question arises whether the supplements exert their effect as nutrient media or as regulators, on the growth of callus tissues. Their use is rarer today than was in the past. They were and are used even today primarily as an N-source, as an amino acid supplement (KOBLITZ 1972, MURASHIGE and SKOOG 1962). According to STEWARD and SHANTZ (1956), CH is not a specific stimulator, but on the isolated tissue of *Daucus carota* it caused even a 25—100% increase, in growth, especially when other stimulators, for example CM or *Aesculus* fruit-abstract, were also present in the mutrient medium. CAPLIN (1956) experienced the same with carrot cultures. PÉLET et al. (1960) found that CH is efficient in 3—10 g/l concentrations in the normal and tumourous tissues caused by insects in the grapevine. HILDEBRANDT (1962) confirme that the various concentrations of CH exerted stimulatory effect on the tissue cultures of sunflower. MURASHIGE and SKOOG (1962) examined the effect of CH in detail. They used the preparation called "edamin" in their experiments. This in an enzymatic abstract of lactoalbumine, which increased the fresh weight and dry matter content of the tobacco callus tissue twice to five times of their original amount. Where it did not effect the weight increase, the N-content of the nutrient medium was usually very high. NH_4NO_3 cannot be substituted for N equivalent with the preparation. The effect of the applied preparation was varying; in general it showed a stimulatory effect when dosed together with IAA and K. These two latter substances, when applied in proportions harmonic with growth, considerably raised the growth rate. Our experimental results on the one hand support these observations, and on the other hand they also allow the conclusion that the question is not simply a supplementing of nitrogen. Casein hydrolysates in certain nutrient media sufficiently provided with growth regulators

can be considered as "supplementary regulators", since they regulate, in addition to weight increase also the proportion of dry weight and the changes in cell number. Their influence on the mechanism of regulators of a "harmonic" composition (series A in Table 2) also suggests this conclusion. Sorbitol present in aminofusin also contributes to the inhibition. Its stimulating effect has not been observed so far on tissue cultures (GAUTHERET 1959). As a general inference from the experimental data—even without a detailed knowledge of the effect mechanism—it can be stated that the CH-s—although they are not specific regulators—can either increase or decrease the effect of the other hormonal regulators as a function of concentration and of composition, and they are not likely to cause this effect as nutrient substances.

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BIOCLIMATIC STUDIES IN THE ULUGURU MOUNTAINS

(Tanzania, East Africa) I.

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The following study of the microclimate of the natural and secondary vegetation cover of the Uluguru Mountains in coastal Tanzania is part of a complex biosphaera study carried out by the author during 1969—1973. The aims of these studies are to describe the natural vegetation and its floristic composition, to establish the distribution of the described vegetation units, by a detailed vegetation mapping, and to try to define their limiting environmental factors. Than, in the knowledge of the most important factors controlling the distribution of vegetation units, an attempt will be made to establish the agricultural potential of each natural area unit characterized by its vegetation.

In the present paper, the microclimate of four natural plant communities on the NNW slope of Mt. Bondwa will be discussed, and comparisons made with the neighbouring secondary vegetation, mainly that of maize cultures. The microclimate measuring was carried out on 17th February 1971, during the rain break between the short and long rainy seasons of 1970/71. This rain-break period is especially suitable for bioclimatic investigations, because the weather is cloudless and warm, yet the deciduous vegetation of the open woodland is at its optimum, the threes are not leafless, so its microclimate is comparable with that of the forests.

A brief description of the site and its macroclimate

The old cristallic block of the 2668 m high Uluguru Mountains occupies a 60×30 km area in the eastern foreground of the Central African Plateau. This isolated massif is one of the oldest in East Africa. Due to this fact and to the favourable climatic conditions, its flora and vegetation are very rich. The number of endemic species is more than fifty just among the woody plants. The mountains form a relatively high continuous range, roughly NE/SW oriented. This range is divided into two parts by the Mgeta — Bunduki depression. The northern part is a single sharp ridge decorated by a number of steep, rocky peaks, some exceeding 2100 m in height. One of them, the Bondwa peak (2130 m high) and its NNW slope form the area of these bioclimatic investigations. Geologically, this slope consists of Usagarian (Precambrian) granulite rocks.

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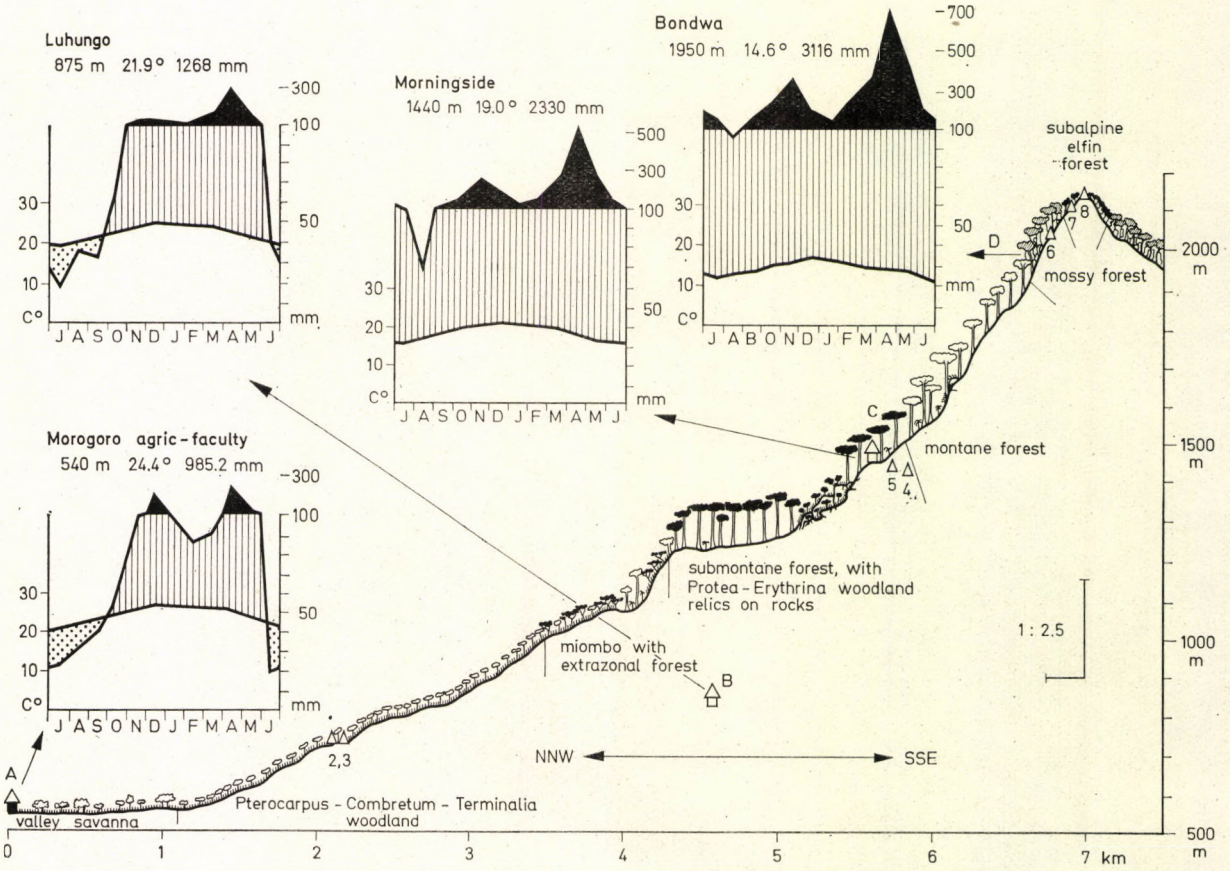

Fig. 1. Vegetation profile of the NNW slope of Mt. Bondwa, showing the macroclimate of the sites in Gaussen–Walter diagrams. A: Mororogo. Faculty of Agriculture Meteorological Station, B: Luhungu rain gauge, C: "Morningside Farm" rain gauge, D: The site of the estimated Bondwa diagram. No-s 2—8 show the exact sites of the measurement plots

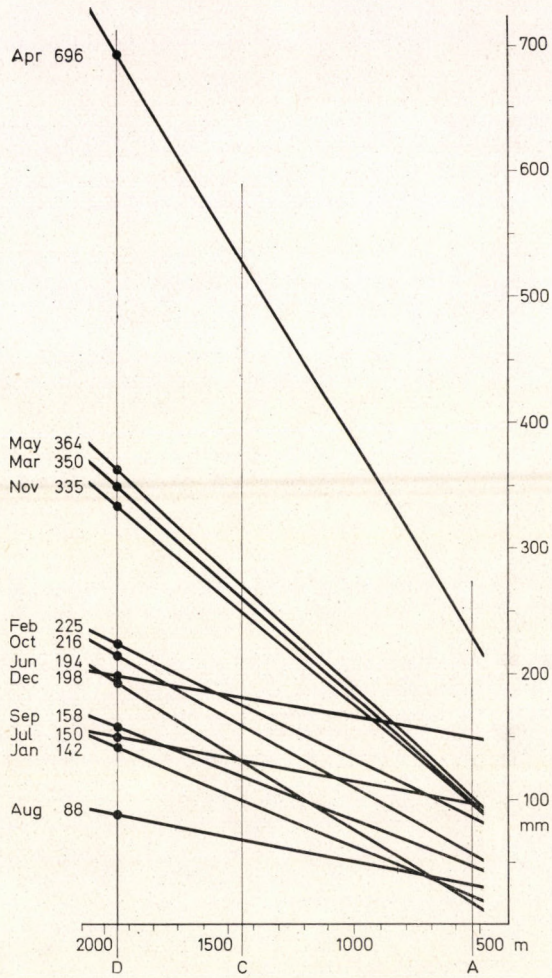

Fig. 2. The calculation of the monthly rainfall averages on Bondwa at 1950 m altitude. (See explanation in the text)

The distribution of vegetation types in the Ulugurus is highly controlled by the direction of the rain-carrying winds and as the main ridge lies almost perpendicular to this wind direction, the vegetation distribution shows a very asymmetric pattern. The research area occupies the western side of the ridge, where, due to the rainshadow effect, the climate is drier than on the fully forest covered eastern slopes. The forest belt here, in natural circumstances, does not descend lower than 1200—1300 m altitude, at least 600 m higher than on the other side (see Fig. 1). This results in a full range of different vegetation types varying from baobab savanna to the most humid types of mossy forests and subalpine elfin forest between the altitudes of 550 to more than 2100

metres. This great variety of vegetation types reflects an equally great variety of local climates on the slope. There is a fully equipped meteorological station at 540 m altitude (Morogoro, Faculty of Agriculture) and two raingauges (Luhungo, 875 m, and Morningside, 1440 m altitude) within our microclimate investigation area. These stations give some idea of the distribution of climatic elements. However, to obtain a full picture, we needed both the rainfall and the temperature data. The latter is measured only in Morogoro, so I estimated by interpolation the probable temperature grades for the two raingauge stations (I calculated the temperature/altitude gradients for the whole of Tanzania in different climatic conditions, but this is to be published in another paper). On this basis it was possible to compile the GAUSSEN — WALTER diagrams of the three stations (see Fig. 1 A, B and C). These gave a rough idea of the local climates between 540 and 1440 metres. It is easy to distinguish the savanna and woodland climates (A and B) from the submontane forest climate (C) by the presence or absence of a definite dry season. By extrapolation of the rainfall data of Morogoro and Morningside, I tried to calculate the probable monthly rainfall of the mossy forests at 1950 m altitude. The calculation was based on the fact that the rainfall/altitude gradient varies in different months of the year. The results were graphically obtained (Fig. 2.), where the ordinata A represents Morogoro, C Morningside and D the obtained values for Bondwa top at 1950 m altitude. The results are summarized in a GAUSSEN — WALTER diagram shown in Fig. 1/D. The diagram shows a typical montane rain forest climate. The amount of rainfall is high throughout the year, without being interrupted by a longer dry period. This climate is typical of the greater part of the eastern slopes too, where even at 975 m altitude (Tegetero Mission) there is still no regular dry period and the average rainfall, taken after 30 years of measurement, is 2887.5 mm a year.

In the research area I conducted measurements of the finer distribution of the rainfall according to the orographic pattern. On different slopes and ridges at different altitudes and vegetation types I measured the amount of rainfall during the rainy periods of the year 1972. I intend to discuss the details of these investigations in another paper — here, only the connection between the amount of rainfall and the altitude above sea level on the NNW slope of Bondwa is represented. Figure 3 shows the measured rainfall amounts in different rainy periods of the dry season and at the beginning of the rainy season. The rainfall amount is much more important during the dry season, when it really is a limiting factor, while during the rainy season, in most parts of the Ulugurus, there is surplus rainfall and only a part can be used by the vegetation and by the crops. The diagram clearly shows a very sharp maximum in all periods at altitudes between 1900 and 2000 m. On the NNW slope of Bondwa the altitude of rainfall maximum probably coincides with an effect of the peak itself. The raincarrying winds jumping over the peak, cause a turbulence of

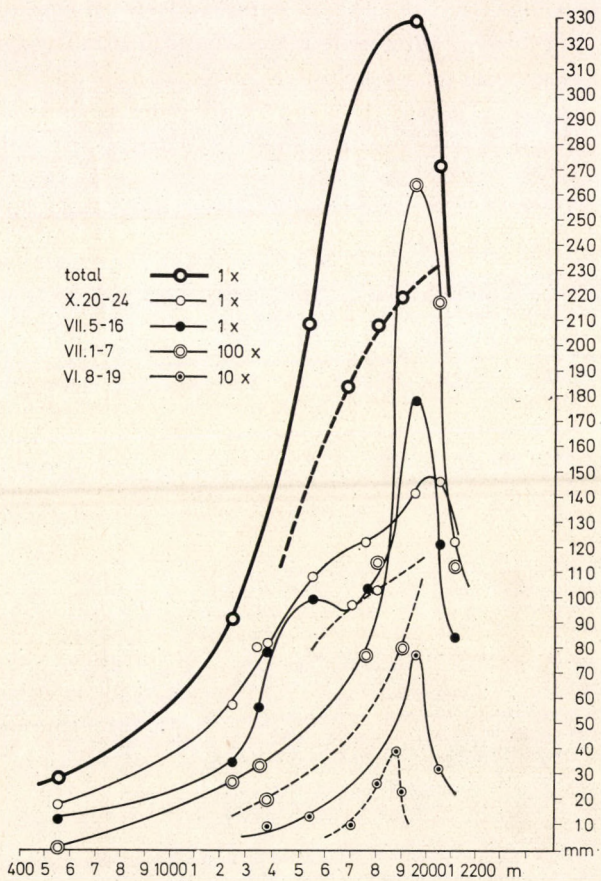

Fig. 3. Rainfall at different altitudes on the N slope of Bondwa. The full lines indicate the rainfall amount on the more exposed NE ridge and top, the broken lines indicate the rainfall amounts measured on the NW ridge and valley lying in rain shadow

clouds on the upper part of the rain-shadow side, which gets in this way, below the peak, as much rainfall as the rainy slope, while the peak itself remains much drier. The vegetation distribution underlines this observation: Both on the SE and NW slopes of the peak, at 1900—2000 m altitude, are found the most luxurious mossy rain forests. Above 2000 m the height of forest decreases and above 2100 m gives place to a dwarf, subalpine elfin forest, sometimes on shallow soil substituted by an Ericaceous heath.

The fact, that temperature decreases with altitude has a definite effect near the top, especially regarding the minimum temperature during cloudless nights. I observed an obvious frost effect on the summit vegetation in October 1972, at the end of the dry season. The leaves of tree ferns (*Cyathea manniana* and *Alsophila schliebenii*) and some succulent epiphytes (*Impatiens schliebenii*)

were highly damaged by frost. These frosts cannot occur too often, because during my four years stay and investigations in the Ulugurus I visited the top of Bondwa more than twenty times and this was the first and last time I have seen any effect of frost. The vegetation fully recovered from the damage within three months. I have never discovered any frost effects below 2050 m altitude.

A short characterization of the vegetation on the various measurement plots

Station No 2. (see Figure 4)

Open, often burnt *Combretum-Pterocarpus* woodland along the land-rover road from Morogoro town to Morningside. The station is near Towero Primary School, at 750 m altitude, on the upper third of a W hill slope, inclination 25—35°, on deep red lateritic (ferralitic) soil with erosion gullies.

Fig. 4. The open *Combretum—Pterocarpus* woodland of the Station No. 2 at 750 m altitude

The crown layer is formed by 3—10 m tall, crooked trees covering 30% of the surface, Diameter of trunks: 15—40 cm. Codominant species: *Combretum zeyheri* Soud. 10%, *Julbernardia* cf. *globiflora* Troupin 3%, *Syzigium guineense*

(Willd.) DC. 5%. *Anona chrysophylla* Boj. 3%, *Pterocarpus angolensis* DC. 3%. This scattered tree layer is obviously diminished by the frequent bush fires and in more natural condition, covers more than 60% of the surface.

The shrub layer is confluent with the tree layer, formed by 1—2.5 m tall shrubs, covering 45% the area. Codominant species: *Brachystegia* cf. *bussei* Harms 10%, *Syzygium guineense* (Willd.) DC. 8%, *Anona chrysophylla* Boj. 6%, *Julbernardia* cf. *globiflora* Troupin 5%.

The herb layer consists of 80—140 cm tall grasses, covering 80%. Codominants are the *Hyparrhenia rufa*, 40%, and *Sporobolus pyramidalis* P. Beauv. 30%. All other herbs, including a few sedges and dicotyledonous plant, are subordinated. A very poorly developed moss layer, consisting of *Fissidens*, *Philonotis* and *Syntrichia* spp., covers only the shady, vertical sides of erosion gullies.

Station No. 3

A maize field near to the previous station in the Towero Primary School area, in the same position as Station No. 2. At the time of our measurements was well before harvesting, the maize cobs had not yet developed.

Station No 4. (*See Fig. 5*)

Submontane, semi-evergreen rain forest near the lower edge of the Forest Reserve, on the NNW slope of Bondwa, above Morningside, at 1430 m altitude, on the W slope of a valley, inclination 40°. The canopy consists of two layers. The emergent one, which is 30—45 m tall, covers about 30% of the surface, diameter of trunks: 40—60 cm, codominant species are: *Albizzia gummifera* (Gmel.) C.A. Sm., *Myrianthus holstii* Engl., *Newtonia buchananii* (Baker) Gilb., *Ocotea usambarensis* Engl. and *Afrocrania volkensii* (Harms.) Hutch. A second tree layer is formed by less high trees of about 6—20 m in size. This second layer, as is usual in rain forests, is much more dense than the previous one, covering about 80% of the surface. The diameter of trunks varies from 15 to 35 cm. Codominant species are: *Mitragyna rubrostipulata* (K. Schum.) Havil., *Mussaenda monticola* Krause, *Cussonia spicata* Thunb., *Afrocrania volkensii* (Harms.) Hutch., *Zenkerella sp. aff. egregia* and *Cyathea manniana* Hook. Epiphytic ferns and orchids and epiphyllous liverworts are common, especially near the stream.

The shrub layer consists of 1—4 m tall specimens, covering 60%. Codominant species are: *Piper capense* L. f., *Piper umbellatum*, L., *Marattia fraxinea* Sm. (rhizomatous fern with leaves reaching 3—4 m size!).

The herb layer covers 45% of the surface, height 40—120 cm. It can hardly be characterized by any dominant species. Ferns, broadleaved grasses

and sedges, several species of Impatiens and many other dicotyledonous plants form a very variable vegetation carpet. The moss layer is well developed only on rocks, tree stems, fallen logs and roadcut surface, not on the soil surface in the forest. The soil is yellow, lateritic, acidic.

Fig. 5. The Station No. 4 in submontane rain forest of 1430 m altitude. Tree ferns (*Cyathea manniana*) on the left side of the picture

Station No 5.

A maize field at 1435 m altitude, very near to the previous station and to "Morningside" rain measuring station by the transformer house. The area formerly was covered by the same type of forest as Station No. 4. Nowadays shifting cultivation is carried out here. At the time of measuring it was covered by already harvested maize.

Station No. 6 (See Figures 6—7)

A high montane, mossy rain forest on the NNW slope of Bondwa, just below the top, at 2020 m altitude. Inclination of the slope: 40°.

The trees form a simple crown layer of 15—25 m height. Coverage: 80% of the surface. Diameter of the stems: 20—80 cm. The forest is interwoven by many lianas and epiphytes. All stems, branches and aerial roots are covered

Fig. 6. High montane mossy forest on Bondwa peak at 2020 m altitude. In the foreground tree ferns (*Alsophila schliebenii*) and *Dracaena afromontana*, Station No. 6

by a thick carpet of bryophytes. On the more horizontal branches long curtains and beards of mosses hang down. The biotope is very humid throughout the year, effected by the almost continuous mist cover. Codominant trees: ***Allanblackia sacleuxii*** Hua, ***Podocarpus milanjianus*** Rendle, ***Melchiora schliebenii*** (Melchior) Kobuski, ***Schefflera barteri*** (Seem.) Harms var. ***barteri***, ***Cussonia lukwangulensis*** Tennant, ***Cyathea manniana*** Hook.

The shrub layer is dense, covering 85%, 1.5—5 m tall. Tree ferns, ***Dracaena*** sp., are intermixed with different, 1—2 m tall, half woody ***Acanthaceae***, mainly ***Mimulopsis*** spp. Typical, but not dominant shrubs: ***Solanum schumannianum*** Dammer, ***Trema orientalis*** (L.) Bl., ***Lasianthus pedunculatus*** Bruce, ***Zenkerella capparidacea*** (Taub.) Léon and the endemic wild banana of Ulugurus with thick pseudostem: ***Ensete ulugurense*** (Warb. Moritz) Cheesman.

In the herb layer, which covers 65% of the surface, different ferns, *Selaginella kraussiana* (Kunze) A.Br., orchids, as *Calanthe volkensii* Rolfe, dicots, as *Impatiens ioides* C.M. Schulze, *Elatostema orientale* Engl. are dominant. On the tree stems are climbing the *Blechnum attenuatum* (Swartz) Mett. and the *Begonia meyeri-johannis* Engl. On shady rocks, fallen logs and

Fig. 7. Moss covered stems and lianas in the mossy forest. Bondwa. 2020 m altitude

as epiphytes two endemic African violet species are to be found: *Saintpaulia goetzeena* Engl. and *Saintpaulia pusilla* Engl. The commonest epiphytes are the filmy ferns (e.g. *Hymenophyllum splendidum* v.d. Bosch and *H. capillare* Desv.). The moss layer is well developed even on the soil and covers 45% of the soil surface. The soil is yellowish brown and the humus layer is very thick.

Station No. 7. (See Fig. 8)

Subalpine, dwarf elfin forest on the top of Bondwa, right on the E side of the summit, on a narrow ridge pointing a south-eastern direction. The inclination of the spine of the ridge is 15°. The canopy is very dense, coverage over 90%. It is formed by dwarf, 4—6 m tall, flat crowned, umbrella-like

Fig. 8. The elfin forest on the top of Bondwa at 2125m altitude. Station No. 7.

trees, like the dominant *Syzygium parvulum* Mildbr. (45%) and the subdominant *Podocarpus milanjianus* Rendle (15%).

The shrub layer is dense (80%) and is interwoven by many white flowering, half-woody *Acanthaceae* and tall ferns like *Blotiella glabra* (Bory) Tryon.

The herb layer covers 15% and consists of 10—60 cm tall herbs. Codominants are the smaller specimens of *Blotiella*, *Cryptotaenia africana* (Hook. f.) Drude, *Cincinnobotrys oreophila* Gilg. and the very characteristic, crimson-red *Impatiens uluguruensis* Warb.

All tree stems, lianas and branches, including the tiniest twigs, are embedded in a dense moss fur. This bryophyte cover is able to absorb more than 20,000 litres of water per hectar during one rain (detailed data to be published later). The soil is also covered by bryophytes, up to 40%, is peaty in the upper 20—40 cm due to a water isolating bluish-grey layer below.

Fig. 9. Reading of data at the stations No. 5 (upper), No. 7 (left) and No. 8 (right)

Station No. 8

An uncovered, artificial short grassland area around the telecommunication aerial on the very top. Wind exposed, open habitat.

Methods used for measurements

The air temperature at each station was measured every half hour from sunrise to sunset at 1 m and 20 cm altitudes above the soil surface. The temperature of the soil surface was measured in the same time in 2—3 mm depth, when the bulb of the thermometer was covered by a shallow layer of earth. Both dry and wet bulb thermometers were used in the air, to obtain the grade of relative air humidity. The thermometers were calibrated in melting ice and by 25 °C temperature before use. During measurement the bulbes were shaded.

Along with the relative humidity we also measured the evaporation in the different biotopes by home made Piche evaporimeters. The evaporimeters were standard, we used white bolting papers of 3 cm diameter. Both the thermometers and evaporimeters were attached to prefabricated wooden stands. The evaporimeters were read also every half houre, but the evaluation was calculated, as is usual, in hours.

During the measuring day there was no precipitation at the stations. The weather was clear and cloudless most of the time. There were no strong winds, so the biotops could develop their typical microclimate with remarkable extremes.

The data of Morogoro, Faculty of Agriculture Meteorological Station (No. 9637076) on the measuring day were:

Dry bulb thermometer at 9 a.m.: 23.5 $_5$C,
at3 p.m.: 30.6 $_5$C
Wet bulb thermometer at 9 a.m.: 20.8 $_5$C
at 3 p.m.: 22.6 $_5$C
Dew point at 9. a.m.: 19.4 $_5$C
at 3. p.m.: 18.6 $_5$C
Maximum temperature: 32.2 $_5$C
Minimum temperature: 19.4 $_5$C
Anemometer, wind run in miles from 17 to 18th February morning: 87,2
Rainfall: 0
Sunshine: 8.6 hours (the valley below 700 m altitude was covered by low mist clouds in the morning hours)
Radiation: 467 Longleys
Evaporation in mm: 7.8
Max. rest C_5: 24.4
Min. rest C_5: 24.0

The Evolution of the Measurements

A. Temperature (See Figures 10—11)

As was expected, the highest temperatures were measured at the lowermost stations No. 2 and 3. While the soil surface temperature in the open woodland reached 36.5 °C and the air temperature at 20 cm and 1 m altitude did not show significant differences (maximum about 33 °C), in the unprotect-

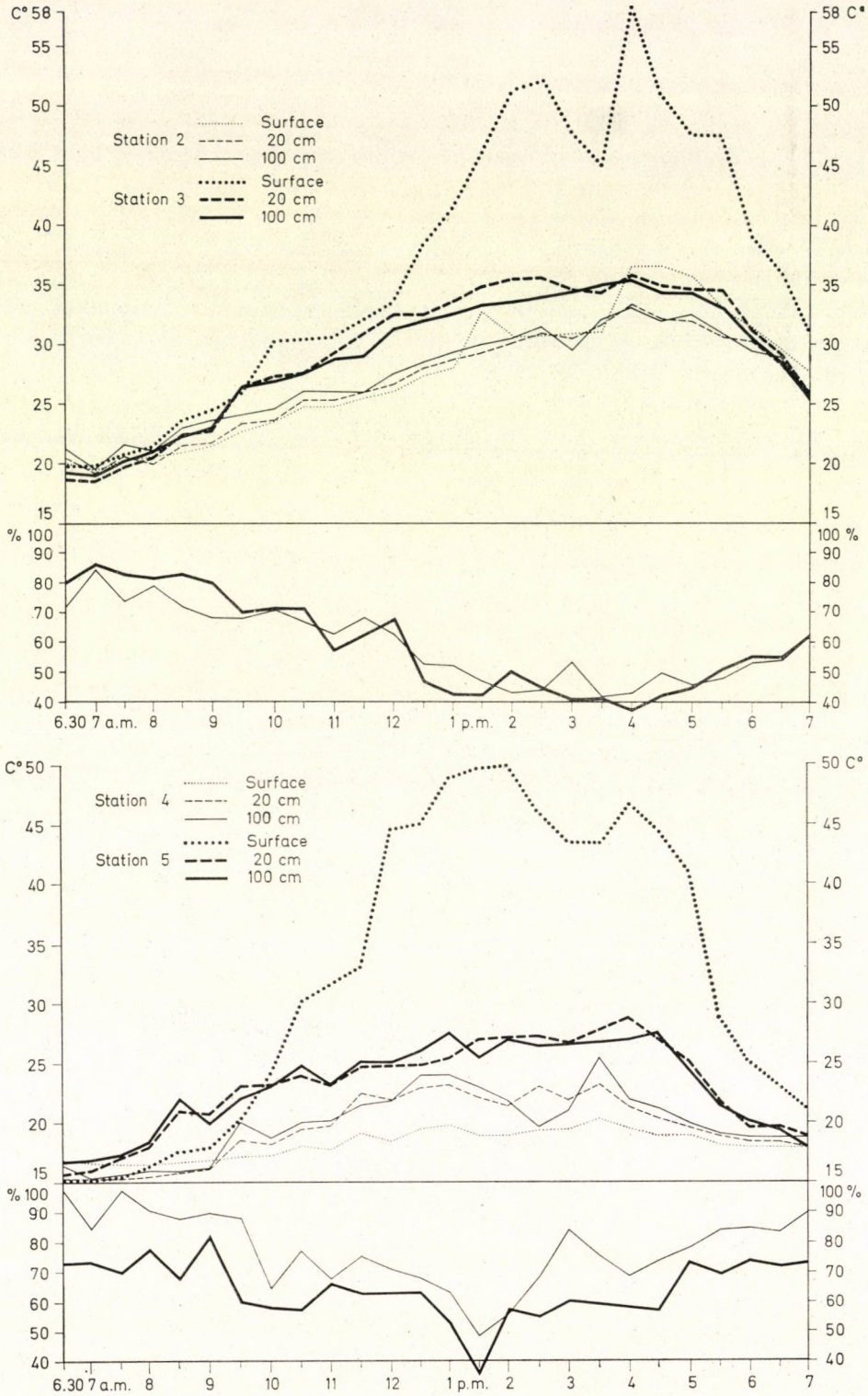

Fig. 10. **Temperature (upper parts) and the relative humidity (lower parts of diagrams) at the stations No. 2 (open woodland), No. 3 (maize field at 750 m), No. 4 (submontane rain forest) and No. 5 (maize field; at 1430 m altitude)**

ed maize field the soil surface temperature reached such extremes as 58 °C, taking over the role of the active surface. This fact shows the very significant temperature modifying effect and soil moisture protecting role of an even scattered tree and bush layer above the soil. It is to be noted, that the maximum temperature readings on the western slope were taken late afternoon (4 p. m.).

The temperature maxima at the other stations showed a similar ambiguity but the values decreased with altitude. The gap between the maximum temperatures of forest and open maize field soil surface at 1430 m altitude is even broader: 20—50 °C, due to the strong shading effect of the closed forest. In the submontane rain forest a typical inversion of temperatures developed. The shrub layer at 1 m altitude showed the highest temperatures (which was probably even higher in the canopy). By day-time the soil surface was the coolest, not playing any active role in the irradiation. The air temperature at both stations shows a moderate fluctuation of between 15—28 °C.

By far the most even temperature course was measured at a high altitude, mossy rain forest at Station No. 6. The fluctuation between minimum and maximum is very little: only 4.25 centigrades at the soil surface and 4.00 centigrades in the air. This is due to the very dense vegetation cover, high air humidity and the very well balanced macroclimatic conditions. This mossy rain forest, called also mist forest, lies in the mist belt of the N Ulugurus, which altitude (1800—2000 m) is characterized here by a very strong cloud formation even during the dry season. On misty days, which at this altitude is the normal case, the temperature curve is flatter, without any extremes. It is a typical cool "greenhouse" or "fernhouse" microclimate, characterized by the very high number of ferns, especially filmy fern (*Hymenophyllaceae*) species.

The temperature in the subalpine elfin forest (Station No. 7) shows much a larger fluctuation (between 10—22.5 °C, 12.5 centigrades compared with the 4 centigrades of the former station !). The maximum temperature, as occurs in the woodland, develops in the late afternoon. But here it is due to a very different reason: at this time the dew, which was absorbed during the night and early morning by the thick moss cover, has evaporated and the dwarf forest dries out a bit for a few hours. The soil surface reaches its maximum temperature even later, being peaty and very wet.

If we compare the last two stations with the open top of Bondwa, we have to notice a still large difference. The open grassland on the peak gets warm quickly and the air temperature reaches its maximum shortly afternoon. On the other hand the air cools down much earlier than in the elfin and mossy forests.

As far as the minimum temperatures are concerned, they were measured in all plant communities but one at 7 a.m., shortly after sunrise. The values

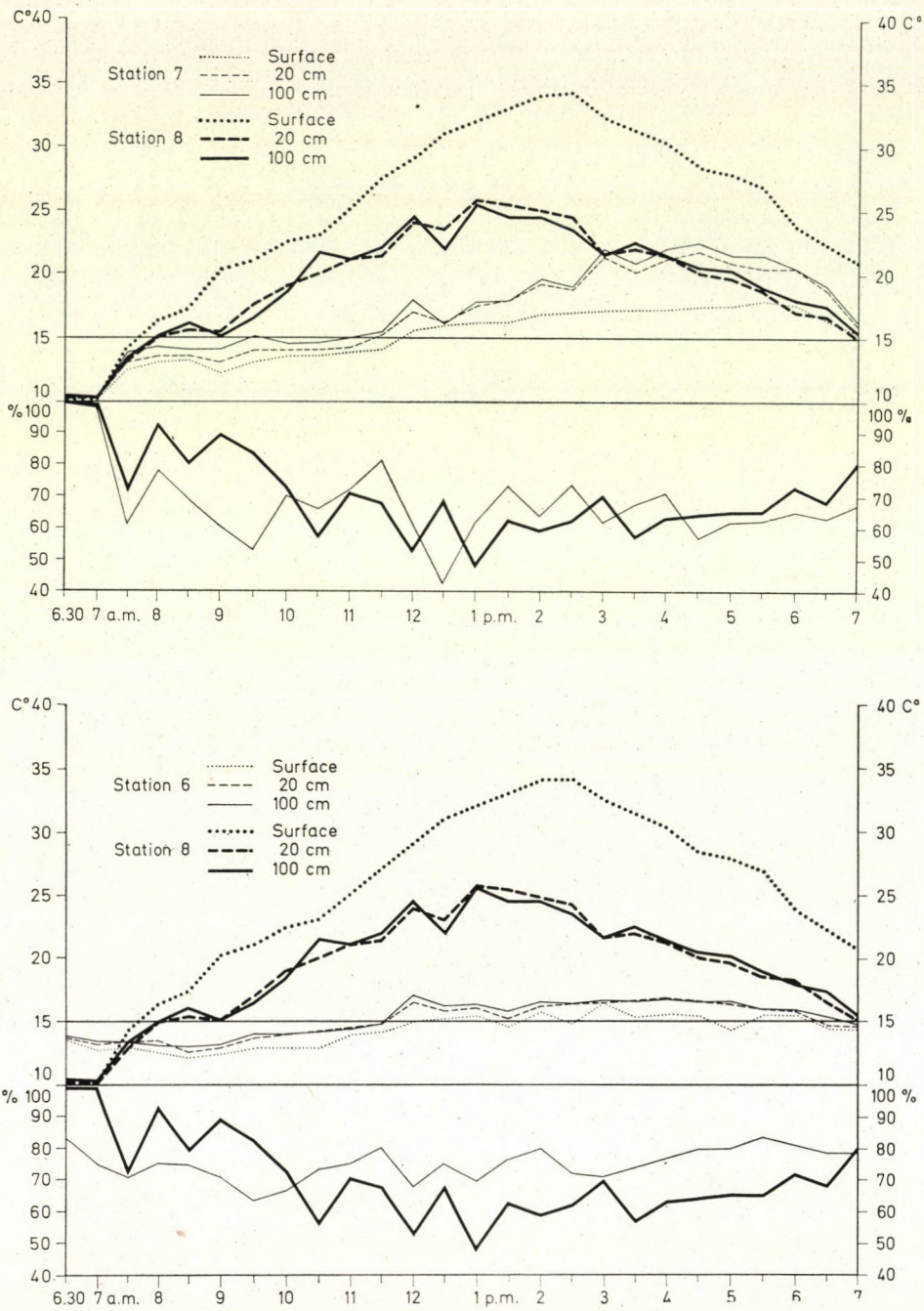

Fig. 11. Temperature (upper parts) and the relative humidity (lower parts of diagrams) at the stations No. 6 (high montane mossy forest). No. 7 (subalpine elfin forest) and No. 8 (open summit) at 2020 m and 2130 m altitudes

show a very regular gradient: near 20 °C at 750 m, 15—17 °C at 1430 m, 12—13 °C at 2020 m and 10 °C at 2230 m altitude. The mossy forest, due its very high air humidity, reached its minimum temperature much later, at 8.30 am.

B. Relative humidity (See Figures 10—11 below the temperature curves)

The relative humidity has its maximum at 7 a.m. when the temperature is at its minimum and the minimum values coincide with the temperature maxima. When the pairs of stations are compared, the difference of relative humidity values between the closed plant community and the open field is the smallest in the case of the woodland and the largest in the case of the submontane and the mossy forests. The minimum grade of relative air humidity sinks below 40% in the woodland zone and on the maize field of the submontane forest zone. The maximum grade of relative humidity in the forest belt reaches 100%, but in the open woodland during the measuring day it never went higher than 85%. It is a remarkable fact, most probably a result of the dew effect in the open habitats, that in most cases the relative humidity in the first 3—4 hours of the morning is much higher in the open plant communities than in the dew protected forest interior. The mossy forest is conspicuous because of its very well balanced, 64—84% relative humidity throughout the day, similarly to the very even temperature. In closed forests the relative humidity never sinks below 50%, even during this very dry climatic period.

C. Evaporation (See Figure 12)

The evaporation values reflect best the relationship between plants and climatic environment, because they somehow summarise the temperature, air humidity and air movement conditions important for the plants. By measuring the evaporation simultaneously in places covered by natural vegetation and in open field, the protective effect of plant cover for the moisture in the soil and in the plants is also clearly shown.

As was expected, the highest values were measured in the open woodland of 750 m altitude, in the neighbouring maize field, and in the maize field of the submontane forest belt. All forest stations show a well-balanced, moderate evaporation. Again the mossy forest was proved to be the most balanced plant community with a very moderate and even evaporation curve. The gap between the evaporation in closed and open communities is the widest in the submontane forest zone, where the forest is already very closed, the air is saturated and the habitat is well protected from winds. On the other hand the air above the maize field still gets pretty warm even at this moderate altitude and the

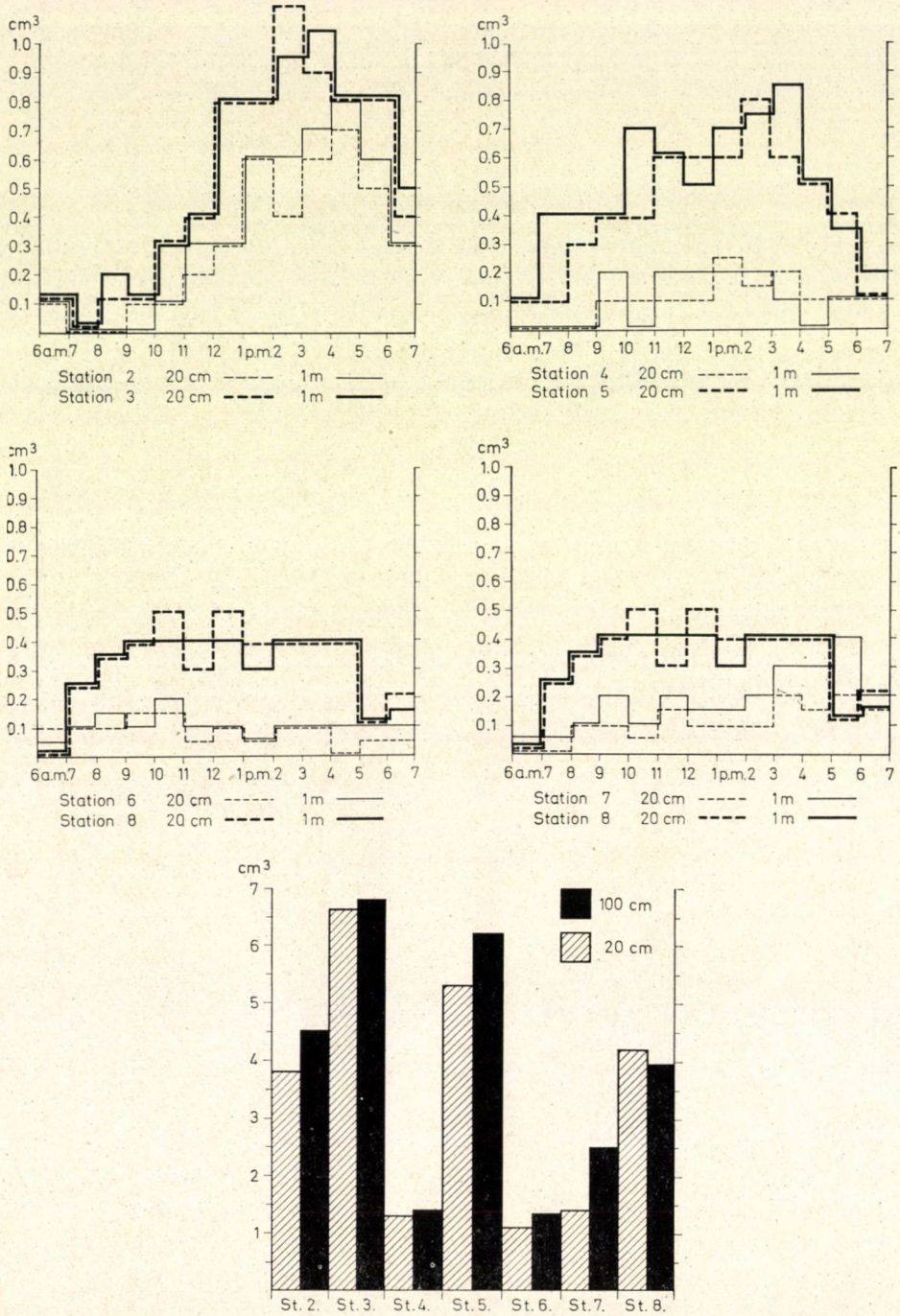

Fig. 12. Evaporation in cm^3/hours compared at the parallel stations (four upper diagrams) and the total daily evaporations from 6.00 to 19.00^h measured at the different stations (lower diagram)

evaporation is effected by this high temperature. On the open top the evaporation readings are still quite high. This is more the effect of the breeze on the sharp ridge and the varying air humidity than the air temperature, which does not exceed 25 °C.

Conclusions

The highest extremes of microclimatic factors are shown in the open woodland and in the cultivated areas, as compared to the well-balanced conditions of the forest. The open woodland — in this secondary stage, often effected by bushfires — takes an intermediate position from the microclimatological point of view between the forest and cultivated land.

The negative effect of the removal of a protective vegetation cover is most striking in the submontane forest belt, near the natural border of the forest and woodland zones. This is an important fact from an agricultural point of view, because this zone is the most productive area in the Uluguru Mountains and the most densely populated. The picture is quite similar in the Kilimanjaro Mountains, where the most productive coffee-banana zone lies also at the natural border of woodland and forest belts. However, there the situation is slightly different, because the slopes of Kilimanjaro are much more gentle and the deforestation did not go so far. Therefore, the deteriorating effect of soil erosion and strong insolation is much less than in the Ulugurus. In the Kilimanjaro area an intensive reforestation is under development, and even the smallholders plant many windbreaks and shadetrees. But, in the Ulugurus the local farmers have cut almost all the trees on the slopes down below the Forest Reserve and encroach upon or damage the lower edge of the Forest Reserve almost everywhere. The high productive zone, deprived of its tree cover, evaporates four times as much as the area under vegetation protection. This is a combined effect of higher insolation and uncontrolled air movement — winds.

The evaporation data obviously suggest, that by well designed reforestation in the cultivated zone a great amount of irrigation water could be saved and, protecting the plants from the too high evapotranspiration, the yield could be increased. This reforestation programme does not necessarily mean that a large area of cultivated land should be turned into forest plots. Instead of this, windbraking treelines, shadetrees could be planted in a network dense enough to control the waterloss as is done around Bunduki in the Ulugurus. At the same time this could help the montane villagers to obtain enough construction and firewood in the area, stopping the illegal timber cutting in the Forest Reserve and also helping to control the soil erosion, which ruins the fertile soil layer in very large areas of the Ulugurus. For erosion control all steeper slopes not suitable for cropping could be reforested.

This reforestation could be realised by fast growing and straight stemmed timber species in mixed cultures. The proposed species in the different vegetation zones of the western slopes of Ulugurus are:

600—1200 m: *Cassia* spp., *Eucalyptus* spp., *Pinus massoniana* Lamb., above 1000 m with *Pinus caribaea* Morelet

1200—1800 m: *Eucalyptus* spp., *Acacia mearnsii* De Wild., *Grevillea robusta* A. Cunn., *Cupressus lusitanica* Mill., above 1400 m with *Pinus patula* Schlecht. and Cham.

These species are already applied with success in limited areas by the Forestry, missions and privates.

An other way of better soil protection and water control seems to be a more intensive cultivation of woody and half-woody crops such as tea, tung (*Aleurites*), *Cinchona* spp., either in pure cultures (tea) or in a form of intercropping (others).

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EINIGE GRUNDSÄTZLICHE FRAGEN DER PFLANZLICHEN ONTOGENESE

Von

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In the introduction the author reviews the historically important initial stages of the research and interpretation of plant ontogenesis. He emphasizes the great merit of HOFMEISTER in the discovery of the regular alternation ("alternation of generations") of the two kinds of reproduction which is generally characteristic of the life cycle in Embryophyta. — Then the author outlines the essence of contradictions in newer examinations, results and interpretation arisen up to now in the decades after HOFMEISTER. Some of them are randomly chosen for a comparative analysis. Thus the author treats the question of the definition of the individual, the modern interpretation of plant "generation" succession, the peculiar nomenclature by WIDDER, the vegetative form alternation, within life cycle, the critical points in the development of the individual in *Fucus*, some examples of discontinuous and continuous ontogenesis, finally the questionable validity of the two sporophyton phases (Embriosporophyton-Tetrasporophyton) introduced in *Angiospermae* by WIDDER, as well as the criticism of STIEBER's conception (that the endosperm of *Angiospermae* is the third stage of development in the individual).

Vom Zeitalter der Kräuterbücher ausgehend erwähne ich zuerst die umfangreiche Tätigkeit von CAESALPINUS, der neben seinen taxonomischen Forschungen seine Aufmerksamkeit, wenn auch nicht der ganzen Ontogenese, so doch der Entwicklungslehre der verschiedenen Organe widmete. In seinem Werk »De plantis libri XVI« (1583) betrachtet er den Knospen gegenüber den Samen als das vollkommenere Fortpflanzungsorgan und erklärt seine Entwicklung, gemäss der Anschauung seines Zeitalters, in folgender Weise: 1. Das Innere des Samens im heutigen Sinn: Embryo und Endosperm stammten vom zentralen Teil der Pflanzen, dem Markgewebe, 2. die verholzte Samenschale organisiert sich aus dem Holzkörper, 3. das Perikarp (die Fruchtwand) entsteht aus der Rinde.

Seines Erachtens kommt die Blüte nur als Schutzvorrichtung des Samens in Betracht. Wir wissen ausserdem über zahlreiche andere interessante morphogenetische Konzeptionen von CAESALPINUS die sich jedoch als irrtümlich erweisen sollten und eigentlich von der Wirklichkeit noch entfernte Vorläufer der von LINNÉ umrissenen und von GOETHE enwickelten Lehre der Metamorphose waren.

Um die Jahrhundertsende (1592) gibt es noch immer zahlreiche Ungewissheiten in der Deutung der geschlechtlichen Fortpflanzung, des Befruchtungsvorganges, wenngleich beispielsweise der Prager Professor A. ZALUZIANSKY in seinem Werk »Methodi herbariae libri« von den Geschlechtverhältnissen der Pflanzen und von der Erscheinung des männlichen bzw. weiblichen Geschlechts innerhalb einer einzigen oder an verschiedenen Pflanzen schreibt (Monözie, Diözie). Über den Befruchtungsvorgang standen aber lediglich Hypothesen zur Verfügung.

Erst hundert Jahre später, nach der Erfindung des Mikroskops, konnte die Frage richtig erläutert und auf dem Versuchsweg behandelt werden, als R. J. CAMERARIUS, Professor der Medizin in Tübingen die bisherigen und zeitgenössischen Kenntnisse mit eigenen Beobachtungen ergänzend, im Jahre 1694 sein Werk »De sexu plantarum epistola« veröffentlichte und damit die Grundlagen der weiteren Forschung niederlegte.

Das 18. Jahrhundert, d. h. LINNÉS Zeitalter brachte bekanntlich einen wesentlichen Fortschritt im allgemeinen biologischen Denken, so u. a. um näheren Studium der entwicklungsgeschichtlichen Fragen, in der Ausarbeitung der verschiedenen Ansichten und Erklärungen was sich selbstverständlich auch auf den Bereich der Botanik auswirkte; hier war aller-

dings damals noch vor allem die Beschreibung, die systematische Bearbeitung der Pflanzen vorherrschend. Im Bereich der allgemeinen Biologie traten bekanntlich die phylogenetischen und ontogenetischen Probleme und Auseinandersetzungen in den Vordergrund. In der ersten Hälfte des Jahrhunderts wurde die Lehre der Präformation, und in der zweiten die Theorie der Postformation (Epigenese) bereits durch das erhöhte Interesse am Prozess der Ontogenese zwangsläufig entwickelt. Die Theorie der Epigenese (d. h. die Lehre der Organisation nach erfolgter Befruchtung) wurde vom Mediziner und Botaniker KASPAR FR. WOLFF in seinem Werk »Theoria generationis« (1759) ausgearbeitet. Er behandelt den physiologischen Aspekt der Fragen der Organogenie innerhalb der pflanzlichen und tierischen Ontogenese, wo ihn neben den auch heute gültigen Feststellungen und stichhaltigen Beobachtungen, auch Irrtümer und Fehldeutungen unterlaufen; dies ist allerdings auch der damaligen primitiven Instrumenten und Methoden zuzuschreiben. In der Begründung der ontogenetischen Forschungen sind seine Verdienste auch so unvergänglich. Einigermassen als Fortsetzung, aber von WOLFF unabhängig, erschien 1790 das Werk von JOHANN WOLFGANG GOETHE, »Versuch der Erklärung der Metamorphose der Pflanzen«. GOETHE bewegt sich aber immer noch auf dem Gebiet der Organogenie ohne sich in ontogenetische Fragen einzulassen.

Auch in der ersten Hälfte des 19. Jahrhunderts sind die Anatomen vornehmlich mit morphogenetischen, histogenetischen und cytologischen Studien beschäftigt. Folgende Forscher sind hier hervorgehoben zu nennen: SPRENGEL, RUDOLPHI, LINK, vor allem P. MOLDENHAUER, CHR. L. TREVIRANUS, CH. F. MIRBEL, DE CANDOLLE, REICHENBACH, R. BROWN, SCHLEIDEN, MOHL, NÄGELI usw. Unter diesen Forschern sind besonders REICHENBACH und (zum Teil) SCHLEIDEN zu erwähnen, die nicht nur betonten, die stufenweise Erkenntnis der Entwicklung der Organe und des Individuums sei eine der dringlichsten Aufgaben, sondern — vor allem REICHENBACH — behaupteten, im Chaos der Pflanzenwelt könnten sich die Botaniker nur dann zurecht finden, wenn sie die systematische Kategorisierung derselben auf die Ontogenese aufbauen. Merkwürdigerweise hat sich keiner der beiden in Studium des ganzen ontogenetischen Vorganges vertieft, sondern sie beschränkten sich auf die Untersuchung je eines Teilbereiches. — Immerhin können wir SCHLEIDEN als einen der Gründer der pflanzlichen Ontogenese betrachten, der in seinem Werk (1838) den Begriff des Individuums deutlich und richtig zu definieren trachtete. Dies war um so notwendiger, da sich einige seiner Zeitgenossen in dieser Hinsicht zu äusserst irrtümlichen Auffassungen bekannten. So z. B. meinte der Utrechter Professor FR. A. W. MIQUEL noch im Jahre 1833 und der französische Professor MOQUIN-TANDON im Jahre 1851 und sogar auch zehn Jahre später, jede einzelne Knospe, bzw. jeder einzelne Zweig sei als ein effektives Pflanzenindividuum und als Analogie der tierischen Individuen zu betrachten. Alldies zeigt, wie extreme und irrtümliche Erklärungen noch Mitte des vergangenen Jahrhunderts u. a. in der Auslegung der pflanzlichen Ontogenese entstanden sind.

Nur mit Berücksichtigung dieser ungewissen und allzu subjektiv geprägten Verhältnisse können wir die weltweite Bedeutung der Entdeckung von WILHELM HOFMEISTER und seine 1851 veröffentlichten hochbedeutenden Ergebnisse richtig schätzen, mit denen er einerseits das Vorhandensein und die regelmässige Alternation der geschlechtlichen und ungeschlechtlichen Fortpflanzung sowohl bei den Moosen und Farnen, als auch bei der Samenpflanzen, und andererseits die ontogenetischen (bzw. verwandtschaftlichen) Zusammenhänge und Homologien der Heterosporen-Farne und der Samenpflanzen bewies. Als der von HOFMEISTER entdeckte und benannte Generationswechsel (der Name stammt ursprünglich vom Zoologen CHAMISSO) bekannt wurde, hat sich die bislang äusserst heterogene Auffassung über die Ontogenese mit einem Schlag verändert und immer mehr Forscher widmeten sich dem Studium der Ontogenie, der Fortpflanzungsvorgänge und Fortpflanzungsorgane, sowie der Fortpflanzungszellen der Kormophyten, der Thallophyten und der Protophyten. Diese Forschungen führten in der zweiten Hälfte des vergangenen Jahrhunderts bekanntlich zu zahlreichen wertvollen, neuen Ergebnisse und zur Klarstellung von manchen offenen Fragen. Hier nur einige Beispiele: THURET, der die geschlechtliche Fortpflanzung als erster nachwies (*Fucus*), ferner PRINGSHEIM (*Oedogonium*, 1856—58), der Ungar JURÁNYI (*Vaucheria*, 1865), BELJAJEW (*Selaginella*, 1885), GOROSCHANKIN (Samenpflanzen, Funktion des Pollenschlauches), STRASBURGER (Kernteilung), NAWASCHIN (doppelte Befruchtung der *Angiospermae* 1898,), usw.

Fast gleichlaufend mit diesen Untersuchungen wurden die Forschungen zur Aufdeckung der Gesetzmässigkeiten in der Zellteilung und Kernteilung unternommen, die schliesslich in den letzten Jahrzehnten des vergangenen Jahrhunderts zur Entdeckung der Chromosomen sowie zur Erkenntnis der morphologischen funktionellen und zahlenmässigen Charakteristika und der regelmässigen Teilungen führten, die während der Ontogenese erfolgen. Es war naheliegend die gesetzmässige Erscheinung der haploiden, diploiden, und sogar tri-, tetra-, usw. polyploiden Chromosomenzahlen, bzw. ihre teilweise Alternierung (den sog. Kernphasenwechsel) mit dem »Generationswechsel« in Zusammenhang zu bringen, der sich in der Ontogenese manifestiert.

Dies wirft ein neuartiges Licht auf den Prozess der pflanzlichen Ontogenese, weiter kompliziert durch die regelmässige und zuweilen typische Alternierung der vegetativen Körperform. Solche Komplexforschungen nahmen besonders zur Jahrhundertsende einen stärkeren Aufschwung, gleichzeitig tauchten immer mehr erklärungsbedürftige Detailfragen, fragliche Theorien und Auffassungen auf.

Heute sind innerhalb der grossen Verwandtschaftseinheiten bereits zahlreiche Typen der Ontogenese bekannt; doch sind noch viele unbekannte, oder zum Teil bekannte Einzelheiten.

Aus den bisherigen Ergebnissen und dem Vergleich der ontogenetischen Charakteristika der Protophyten, Thallophyten, Bryophyten, Kormophyten und, innerhalb derselben, der Spermatophyten gelangen wir zur Schlussfolgerung dass — abgesehen von einzelnen Algengruppen und Mykophyten — in den meisten Fällen die »geschlechtliche« und »ungeschlechtliche« Fortpflanzungsweise innerhalb eines individuellen Zyklus d. h. im weiteren Sinne: einerseits die Gametophyt — und Sporophyt-Phase, andererseits die haploide (n) und diploide (2 n) Kernphase sowie in zahlreichen Thallophyten, Bryophyten und Kormophyten die vegetative Gestalt regelmässig alternieren. Wir wissen ferner, dass diese verschiedenen »Alternierungen« in einer für die kleineren und grösseren Verwandtschaftseinheiten charakteristischen Weise zumeist parallel erfolgen, doch gibt es zahlreiche Angaben über unterschiedliche Abweichungen, wodurch die ontogenetischen Typen zweifellos abwechslungsreicher werden; (z. B. gibt es neben der diploiden — auch haploide und tetraploide Sporophyten, weiterhin kommen neben den haploiden auch diploide Gametophyten vor). Berücksichtigt man ausserdem die in der Gametophyt-Phase bzw. durch Übertragung in der Sporophyt-Phase der Samenpflanzen auftretende diözische Organisation und die mit dieser zusammenhängende sexuelle homothallische, bzw. heterothallische Entwicklung, so kann die vergleichende Analyse der zwei- oder mehrphasigen Ontogenese mit weiteren Gesichtspunkten erweitert werden.

Es kann nicht unser Ziel sein im jetzigen, beschränkten Rahmen die Ontogenese der Pflanzen in weiterem Kreise zu behandeln. Anstatt dessen möchte ich mit der Erwähnung der häufigsten und bestbekannten Typengruppen (Haplont, Haploidplont, oder Diplohaplont, Diplont) und Typen einige Fragen aufwerfen, zum Teil beantworten, bzw. eine Erklärung suchen.

Bekanntlich haben sich in den ersten aber auch in den letzten Jahrzehnten unseres Jahrhunderts zahlreiche Forscher und hervorragende Wissenschaftler mit vielen, einfacheren und komplizierteren Detailfragen der pflanzlichen Ontogenese, sowie mit ihrer grundsätzlichen und Untersuchungsproblematik beschäftigt. Ich erwähne in alphabetischer Reihenfolge unter anderen z. B. BAUER (1967), besonders BUDER (1916), dann DENFFER (1967), EHRENDORFER (1958), FIRBAS (1967), GOEBEL (1913) HARTMANN (1956), KYLIN (1916), LUCKHAUS (1965), MAHESWARI (1948), MELCHIOR (1964), MÜLLER (1967), RENNER (1916), RESENDE (1967), ROTHMALER (1948), SOÓ (1953), SÁRKÁNY (1969), SIMON (1970). STIEBER (1970), STRASBURGER (1906), WIDDER (1967), WINKLER (1942), ZIMMERMANN (1955). — Zahlreiche wertvolle Ergebnisse wurden erzielt, viele Erklärungen und Theorien entwickelt, manche Zusammenhänge erläutert. Damit wurden HOFMEISTERS Entdeckungen erfolgreich ergänzt, und mit neuen Einzelheiten und Interpretierungen bereichert. — Trotzdem finden wir noch heute zahlreiche ungeklärte grundsätzliche, terminologische, forschungstechnische und Definitionsfragen.

Aus diesen Fragen wählte ich den Gegenstand meiner jetzigen Erläuterungen und möchte sie nachfolgend kurz zusammenfassen.

Nehmen wir zuerst die Definition des Pflanzenindividuums. Es stellt sich nun die Frage, ob es sich um den aus zwei Phasen bestehenden pflanzlicher Lebenszyklus eines einzigen Individuums handelt oder ob zwei Individuen (»Generationen«) von verschiedener Fortpflanzung einen einzigen Lebenszyklus bilden. In diesem Zusammenhang möchte ich auf die Definition von RENNER (1916) und anderer Forscher verweisen, die sich eher auf die »Generation« bezieht und folgendermassen lautet: »Eine Generation ist ein von zwei verschiedenen obligaten Keimzellformen eingefasster Entwicklungsausschnitt, der ein einigermassen ansehnliches vegetatives Wachstum zeigt«. Jüngstens befasste sich unter anderen auch LUCKHAUS (1965) mit dieser Frage, bzw. deutete die Schwierigkeiten in der Definierung der »Generation« an. — Meines Erachtens muss die Frage geklärt werden, was wir unter dem Ausdruck »pflanzliches Individuum« zu verstehen haben. Ich meine, das pflanzliche Individuum unterscheide sich auch in der Hinsicht von dem sich nur geschlechtlich fortpflanzenden tierischen Individuum, dass in seiner Ontogenese im allgemeinen regelmässige Alternierungen der Fortpflanzung, der Chromosomenzahl und häufig auch der vegetativen Gestalt erfolgen und dass sich vielfach zwei oder mehrere, eventuell selbständig lebende, einander bedingende vegetative Körper entwickeln. Die letzteren können nur im weiteren Sinne (bzw. aus genetischen Gesichtspunkt) als Individuen betrachtet werden und repräsentieren eigentlich gemeinsam das pflanzliche Individuum, d. h. eine einzige Generation. — Daraus folgt mein Vorschlag, anstatt des Ausdrucks »Generationswechsel« von einer periodischen oder intermittierenden Ontogenese zu sprechen, da dieser Ausdruck einen viel weiteren Sinn hat und auch für Organismen anwendbar ist, bei denen laut nachstehender Definition von RENNER kein Generationswechsel besteht: ». . . Ein Generationswechsel fehlt, wo Sporen ganz fehlen oder wo zwischen der Zygote und den Sporen kein vegetatives Stadium liegt«.

Zur Unterstützung meines Vorschlages erwähne ich das Schema von WIDDER (1967) über die Grundformen des pflanzlichen Kernphasenwechsels in Kreisdiagrammen. Ohne auf Einzelheiten einzugehen möchte ich lediglich darauf hinweisen, dass man hier in der Vielfältigkeit des Kernphasenwechsels zahlreiche Typen findet, wo es laut RENNERS Formulierung keinen Generationswechsel gibt, während gleichzeitig die Periodizität der Ontogenese (des Lebenszyklus) — d. h. zwei oder mehr Phasen — deutlich erkennbar ist.

Im Zusammenhang mit dem Kernphasenwechsel taucht auch die seit langem umstrittene Frage auf, wann bzw. wo sich — entwicklungsgeschichtlich betrachtet — die grundlegende Eigenart der Organisation entwickelt hat. Hierzu gibt es mehrere Erklärungen. Einige, z. B. ZIMMERMANN (1959, 54—55) meinen, in der Entwicklung des Kernphasenwechsels komme die primäre Rolle der Reduktionsteilung, der Meiose zu, und sie fassen die geschlechtliche

Fortpflanzung als Ausgleichung der Reduktion auf. Andere, so auch STIEBER (1970) sind der entgegengesetzten Meinung. Ich möchte hier auszugsweise aus STIEBERS Publikation zitieren: »Die Zelle ist ein Diskret mit starker und bestimmter biologischer Kohäsion, die von der Abnahme der fürs Leben günstigen Faktoren und demzufolge von der Verteidigung gegen die Umwelt gesteigert, sodann in Adhäsionsaffinität verwandelt wird, woraus sich phylogenetisch eine geschlechtliche Differenzierung ergibt. Die Reduktion ist eine Rückwechslung, und nicht umgekehrt. Das Eintreten der »R«-Phase des Kernphasenwechsels ist also eine Konsequenz, die eine evolutionäre, zum Teil autonome innere Tendenz bewirkt, undzwar die Tendenz der Inklination zur Diploidie bzw. Polyploidie innerhalb der Ontogenese, und dies führte im Laufe der Evolution zur Entwicklung der progressiveren Diplont-Typen.« So weit das Zitat. — Für die Priorität der Gamie sprechen übrigens die »Uplont«-Organismen. Es ist bezeichnend für diese Organismen, dass der Gamie Meiose folgt und dass die entstehenden Einheiten nach gewisser Zeit fähig sind ohne jede weitere Teilung zu kopulieren.

Eine nächste Frage ist: die Bezeichnungen von WIDDER (1967). Er bezeichnet nämlich die die dikariotischen Phasen enthaltenden Typen mit eigenen Benennungen; so unterscheidet er den »Dikaryont«-Typ mit einer dominierenden dikaryotischen und einer kurzen Diploidphase, den »Dikaryodiplont«-Typ mit dikaryotischer und diploider Phase von nahezu gleicher Dauer, den Dikaryo-haplont-Typ mit einer längeren dikaryotischen, einer kurzen Diploid- und einer längeren Haploidphase, und schliesslich den »Dikaryo-diplophaplont«-Typ mit nahezu gleich langer dikaryotischer, diploider und haploider Phase. Diese Spezialfälle des Kernphasenwechsels werfen die Frage auf, ob der aus der Plasmogamie folgende dikaryotische Zustand und der mit der früher oder später nachfolgenden Karyogamie und Chromosomogamie verbundene diploide Zustand ontogenetisch als getrennte Phasen zu betrachten seien, oder ob wir es mit einer spezifischen strukturelle Modifikation der Haplophase zu tun haben. Im weiteren Sinne dürfte diese fragliche Phase eher der Diplophase angehören, doch fragt man sich, ob man ohne Karyogamie überhaupt von einer Diplophase (Diploidie) sprechen kann.

Wiederum gehören zu einer anderen Frage die Gestaltvariationen innerhalb derselben pflanzlichen Ontogenese. Diesbezüglich sind recht ausdrucksvolle schematische Abbildungen u. a. in den Werken von ZIMMERMANN (1953), Soó (1953) RESENDE (1967) und in mehreren Lehrbüchern zu sehen. Diese vereinfachte Skizzen eignen sich vorzüglich dazu, um auf einigen Beispielen die möglichen Unterschiede der Ontogenese innerhalb derselben taxonomischen Kategorie zu veranschaulichen. So wird beispielsweise die Pflanze zuweilen nur von einem haploiden vegetativen Körper (Gametophyt), in anderen Fällen, d. h. bei Diözie, von zwei haploiden vegetativen Körpern oder von einem einzigen Diploidkörper repräsentiert; von einem sog. Generationswechsel

kann also keine Rede sein, aber die Periodizität der individuellen Entwicklung steht doch ausser Zweifel. Falls sowohl in der haploiden als auch in der diploiden Phase vegetative Körper entstehen, dann ist es bekanntlich möglich, dass der vegetative Körper des Sporophytes und des monözischen oder diözischen Gametophyts isomorph wird, doch kommt es auch häufig vor, dass das Sporophyt und das Gametophyt äusserst sind und sich auch in den Dimensionen voneinander unterscheiden; die Lage wird weiter kompliziert wenn der vegetative Körper des männlichen und weiblichen Teiles eines diözischen Gametophyts nicht homothallisch, wie z. B. bei *Halicystis ovalis* oder *Dictyota*, sondern an Form und Dimension verschieden ist, wie z. B., unter anderem in *Laminaria* und *Selaginella*. — Hier ergibt sich also wieder die Frage, wie das pflanzliche Individuum zu definieren sei? Zweifellos haben alle drei Einheiten ihre genotypisch festgesetzte individuelle Entwicklung, doch vertreten sie zu dritt gemeinsam das pflanzliche Individuum bzw. die einzige Generation, die in mehrere, getrennt lebende Phasen aufgeteilt wird. — Kann man bei einer solchen diskontinuierlichen Ontogenese von einem Individuum als einer ontogenetischen Einheit sprechen? Wäre es nicht richtiger bei einem grossen Teil der Pflanzen den Ausdruck ontogenetische Einheit oder auch eine noch passendere Bezeichnung zu benützen und in jedem Fall anzuzeigen, ob die betreffende Einheit diskontinuierlich oder kontinuierlich, eventuell semikontinuierlich ist? Zahlreiche Vertreter der Bryophyten und Kormophyten liefern gute Beispiele für den letzteren Fall. — In der semikontinuierlichen und kontinuierlichen Ontogenese der Kormophyten tritt bekanntlich eine ausgesprochene Progression auf, zum einen mit der allmählichen Reduktion des Gametophyts, zum anderen mit der immer differenzierteren Entwicklung des Sporophyts und schliesslich — von den Bryophyten und Heterosporen-Farnen zu den Samenpflanzen fortschreitend — mit den verschiedenen Funktionswechseln. Gerade die Erkennung und Interpretierung dieser Evolutionsprozesse werfen noch heute zahlreiche Probleme nicht nur bei den Kormophyten, sondern auch in den primitiveren Verwandtschaftseinheiten, so bei den Thallophyten und Protophyten, auf.

Des weiteren möchte ich einige diesbezügliche Fragen erläutern, und so übergehe ich zu einem komplizierten Problem. Hier seien gleich die Widersprüche in bezug auf die Ontogenese des diplontartigen *Fucus* erwähnt. Meines Erachtens organisieren sich in den Konzeptakeln des Sporophyts vor allem nicht Archegonien und Antheridien, sondern Makro- und Mikrosporangien, in denen mittels Meiose je vier primäre Makro- bzw. Mikrosporen entstehen. Diese sind noch zu keinem geschlechtlichen Prozess fähig, wohl aber die aus ihnen mittels Mitose entstehenden Einheiten (8 weibliche und 64 männliche Gameten). Daher finde ich es für unrichtig, den vegetativen Körper des *Fucus* gleichzeitig Sporophyt und Gametophyt zu nennen (z. B. RESENDE, 1967) und die Sporen mit den Gameten zu identifizieren. — Hier besteht

zweifellos eine beträchtliche Reduktion des Gametophyts, seine Beschränktheit auf die Gameten; die schnelle Erscheinung der Gameten nach der Sporenbildung, d. h. die Entwicklung der geschlechtlichen Affinität in den Sporen dürfte von bislang unbekannten, biochemischen oder feinstrukturellen Änderungen abzuleiten sein. — Übrigens gehören die *Fucus*-Arten zu den kontinuierlichen Typ.

Anschauliche Beispiele der kontinuierlichen Ontogenese sehen wir auf den Laubmoosen (z. B. *Polytrichum*), wo es meines Erachtens richtig wäre, die Organisation des Gametophytons in eine Progametophyt- (Protonema) und eine Eugametophyt-Phase aufzuteilen, wo die letztere artcharakteristisch, sowohl monözisch als auch diözisch sein kann.

Des weiteren wollen wir uns mit solchen Fällen der teilweise oder ganz kontinuierlichen Ontogenese befassen, wo einerseits die ständig zunehmende Reduktion des Gametophyts, andererseits die intensivierte Differenzierung und die Dominanz sowie der mit dem Leben und der Verteidigung der Gametophyt-Phase zusammenhängende ein-, zwei- oder mehrmalige Funktionswechsel des Sporophyts deutlich erkennbar sind. — Über die Stufen des Funktionswechsels von Sporophyt kurz nur so viel, das bei der *Selaginella* bloss die Wand der Mikro- und Makro-meiosporen, und teils die beiden Sporangien, nach der sporenreife Funktion wechseln, weil sie im Laufe der Ausbildung der Gametophyten (bzw. des Antheridiums und der Archegonium) und auch danach eine schützende und sonstige Rolle erfüllen. — Dieser Funktionswechsel ist von grösserem Ausmass bei der *Salvinia*, wo das Leben des Makrogametophyts, nicht nur von der Makrosporenwand, sondern auch schon von Makrosporangium begleitet wird. — Endlich erfolgt der dreifache oder noch weitere Funktionswechsel in den Samenpflanzen, undzwar etwas einfacher in den Gymnospermen, am kompliziertesten aber (in mehrfacher Zusammensetzung) in den Angiospermen, wo an der Ernährung, an den geschlechtlichen Vorgängen und als weitere Funktion an der Ausbildung und Beschützung, bzw. Verbreitung des neuen, jungen Sporophyt (des Embryos) auch die Makrosporophyllen (also die Fruchtblätter), so wie unter Umständen oft auch andere Blütenorgane, z. B. Perianth bei *Morus*, Blütenboden bei *Nelumbo*, eventuell die Blütenstände d. h. das reproduktive Spross-System des Sporophyts mittelbar teilnehmen.

Gerade diese verwickelten Organisationsbeziehungen verursachen mehrere verschiedenartige Widersprüche sowohl in der Fachausdrücken, wie auch in der Deutung. — Als Beispiel dazu erwähne ich nur, dass die Staubblätter und der Stempel oft auch heute noch Geschlechtsorgane genannt werden, obwohl die Angiospermen und teils die Gymnospermen keine solchen mehr besitzen; die Pollenkörner werden mit den Mikrosporen identifiziert und doch sind die beider Einheiten nicht zu homologisieren, weiterhin — wie es bekannt — kommen die Mikrosporen durch Meiose, die Pollenkörner (männliches Gameto-

phyt) dagegen durch Mitose zustande. Die Pollenmutterzelle ist nämlich, wie wir wissen, haploid.

Zurückk ehrend zu meinen ontogenetischen Erläuterungen habe ich mit Berücksichtigung der angeführten Gesichtspunkte getrachtet, die fundamentalsten und vielleicht häufigsten Typengruppen der periodischen phasenartigen Ontogenese der Pflanzen mit einigen Beispielen zu veranschaulichen; (s. d. Tabelle).

Zum Schluss erwähne ich noch zwei Fragen. Erstens bin ich mit WIDDERS Feststellung, wonach es in den Angiospermen zwei Sporophytphasen gibt (Embryosporophyt—Tetrasporophyt), nicht einverstanden. Ich glaube nämlich, dass der Embryo in den Spermatophyten infolge der Progression zumeist für kürzere oder längere Zeit zwar in einen Ruhezustand tritt, doch ist das kein Grund von einer eigenen ontogenetischen Phase zu sprechen, denn wir kennen ja Pflanzen (z. B. *Malus*, *Pyrus*), bei denen der Samen unmittelbar nach erfolgter Reife auskeimt ohne dass ein Ruhezustand eintreten würde. Andererseits kennen wir zahlreiche Beispiele, ausser den Bryophyten und Pteridophyten, auch bei den Thallophyten, wo sich das entstandene junge diploide Sporophyt (Embryo) kontinuierlich zum vollwertigen Sporophyt entwickelt. — Im Anschluss an diese Frage möchte ich die Missverständlichkeit der Terminologie »primäres, bzw. sekundäres Endosperm« erwähnen. Bekanntlich ist das Endosperm in den Gymnospermae aus dem vegetativen System des weiblichen Gematophyts durch Funktionswechsel bzw. Funktionsänderung entstanden, und entsteht in den Angiospermae nach den geschlechtlichen Prozess, ist also ontogenetisch nicht zu homologisieren. Es wäre daher angebracht, die Ausdrücke »primär« und »sekundär« wegzulassen, und anstatt dessen von Haploid-Endosperm (bei der *Gymnospermae*), bzw. von Diploid-(*Oenothera*), Triploid- (*Polygonum*, *Allium*), Pentaploid- (*Fritillaria*), Polyploid-(*Peperomia*) Endosperm zu sprechen.

Meine zweite Frage bezieht sich auf die Konzeption, die STIEBER in seiner Arbeit (1970) u. a. dargelegt hat. — STIEBERS Auffassung, wonach in den *Angiospermae* das durch Gamie entstehende, zumeist triploide (seltener tetra-, oder polyploide) Endosperm eine dritte ontogenetische Phase darstellen würde, kann ich aus folgenden Gründen nicht beipflichten:

1) Es stimmt zwar, dass dieses Speichergewebe infolge der doppelten Befruchtung durch ein- oder zweifache Gamie entsteht und eine Progressionserscheinung ist, es kann aber nicht als ein Kettenglied der phasenmässigen Ontogenese betrachtet werden, da es verbraucht wird und keine Fortsetzung hat. In der Fachliteratur gibt es zwar Angaben darüber, dass sich der Embryo aus dem Endosperm entwickelt haben soll, doch sind sie bislang nicht bestätigt. Anders verhält es sich — wie dies auch WIDDER schreibt — mit dem Haploid-Endosperm der *Gymnospermae*, das ganz und gar zur ontogenetischen Phase gehört, da es sich hier eigentlich um die Modifizierung des haploiden vegetativen Körpers des weiblichen Gametophyts in ein Nährgewebe handelt.

GRUNDLEGENDE TYPUSGRUPPEN DER ETAPPENMÄSSIGEN ONTOGENIE DER PFLANZEN

	HAPLONT DOMINIERENDE HAPLOPHASE Zygotenartiger Kernphasenwechsel		HAPLODIPLONT — DIPLOHAPLONT HAPLO- UND DIPLOPHASENARTIGER VEGETATIVER KÖRPER (G+S) Intermediär Kernphasenwechsel				DIPLONT DOMINIERENDE DIPLOPHASE Gametenartiger Kernphasenwechsel
			MIT ABGESONDERTER ORGANISATION Diskontinuierliche Ontogenie			MIT ZUSAMMENBLEIBENDER ORGANISATION Kontinuierliche Ontogenie	
HAUPTGRUPPEN	MONÖZISCHER GAMETOPHYT	DIÖZISCHER GAMETOPHYT	MONÖZISCHER GAMETOPHYT	DIÖZISCHER GAMETOPHYT		MONÖZISCHER GAMETOPHYT	DIÖZISCHER GAMETOPHYT
				Isomorphhomothallische Ontogenie	Heteromorphhomothallische Ontogenie Heteromorphheterothallische Ontogenie	Heteromorphhomothallische Ontogenie	Heteromorphheterothallische Ontogenie Heteromorph-reduzierte heterothallische Ontogenie (Dominierender Sporophyt mit einem dreifachen Funktionswechsel
PROTOPHYTEN		*Chlamydomonas* (mit Isogameten)	*Saccharomyces cerevisiae*				*Navicula* sp.
THALLOPHYTEN	*Botrydium* *Vaucheria dichotoma* *Bangia atropurpurea*	*Ulothrix* sp.	*Cladophora glomerata* Ständerpilz Schlauchpilz *Dictyota dichotoma*	*Halicystis ovalis*- *-Derbesia* sp. *Cutleria multifida*- *-Aglaosomia* sp.	*Laminaria hyperborea*		*Fucus* sp.
BRYOPHYTEN						*Funaria hygrometrica* *Polytrichum attenuatum*	
KORMOPHYTEN		*Dryopteris filix mas*			*Equisetum arvense* *Coniferae* *Angiospermae*	*Selaginella* sp. *Salvinia natans*	*Coniferae:* *Ginko biloba* *Cycas revoluta* *Angiospermae*

2) Meiner Ansicht nach bedeutet im Embryosack der *Angiospermae* die Gamie der Polarkerne untereinander bzw. mit der männlichen Geschlechtszelle nicht unbedingt den Beginn einer neuen Phase der Ontogenese. Es handelt sich eher um einen Zwillingsprozess, so wie er in den tetrasporischen (vier Eiapparate enthaltenden) Embryosacktypen (z. B. *Adoxa*) im Falle mehrfacher Befruchtung vorkommt.

3) Die Formation, die zweifellos eine Progression bedeutet (phylogenetisch ganz neu ist), und die sich aus der durch Gamie entstehenden endospermalen Zygote entwickelt, kann einerseits mit der erheblichen Reduktion des weiblichen Gametophyts, d. h. mit der zumeist zu einem achtkernigen Embryosack vereinfachten Struktur, und andererseits — in indirekter Weise — mit der in der Welt der Lebewesen recht weiterverbreiteter Gesetzmässigkeit der »Nachkömmlingsversorgung« in Zusammenhang gebracht werden. Eines steht fest: wir haben mit einem hochinteressanten Detail der Organisation innerhalb der Ontogenese zu tun.

Dies waren einige herausgegriffene Fragen, die mit vielen anderen einer baldmöglichsten eindeutigen Lösung harren, damit wir die pflanzliche Ontogenese möglichst richtig auslegen können.

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EXAMINATION OF DEVELOPMENT AND GROWTH OF BRACHYPODIUM SILVATICUM AND EUPHORBIA CYPARISSIAS IN OAKWOODS

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The authors conducted the phenometrical examination of two perennial species in a xerothermophilous oak-wood association, in 1970—1971. *Brachypodium silvaticum* and *Euphorbia cyparissias* belong to Hemikryptophyta in the association which survive the winter with a minimum of assimilating surface. In this way they are able to assimilate ahead of species with a geophytous life form. Innovation appears immediately after the ending of the reproductive period in *Brachypodium*, while in *Euphorbia* after 2—3 months following the falling of the seed. The reproductive period, and the RGR maxima in both years appeared one month later in the case of *Brachypodium* than in *Euphorbia*. Growth was more uneven with the latter than with *Brachypodium* in 1970, NAR and RGR became negative already by the end of May, then in July; by the activity of the sterile side shoots, they again became positive, and following this they again became negative. The growth of *Brachypodium silvaticum* is more even, although in the two years of examination it was not uniform; in 1970 it was only in September, while in 1971 — assumably on account of the environmental effects differing from that of the preceding year — it was already in July that NAR and RGR became negative. *Euphorbia* reached its maximal relative growth rate by maximal NAR in both years. Reaching a maximal RGR is not necessarily bound to maximal NAR with *Brachypodium*, it can reach that also by maximal LAR. Nevertheless, on the basis of the data from the two years the correlation between NAR and RGR is significant in this species.

Introduction

With the productive characteristics of plant communities coming into the forefront, various other properties of the community, of its individual components — species — become also important, properties which are related to production, and vary in time. Therefore examinations directed towards plant growth have also increased recently. For the same reason, researches into the development of species, morphological description of development, and the observation of phenological phenomena come also into the forefront. It is becoming ever more clear that the developmental cycles of the individuals of the species are not satisfactorily known; especially those of the perennial species with a composite shooting system and with vegetative means of distribution and reproduction (cf. several publications of the Halle School. Nevertheless, the turnover rate and time of the phytomass of the association (cf. PRÉCSÉNYI 1970) are also the results of these special characteristics, the building up and destroying of the shoots.

In 1970—1971 17 dominant or characteristic species were chosen for observation. Submediterranean xerothermophylous oak forest (*Orno-Quercetum*) in the IBP sample area of the Remetehegy in the Buda Hills (cf. PRÉCSÉNYI—FEKETE—SZUJKÓ-LACZA 1967; SZUJKÓ-LACZA—FEKETE 1971). Two are dominant species of the foliage layer, 2 of the shrub layer, while 13 of the herb layer. The species concerned in the herb layer are all perennial; they belong to 7 families; the distribution in their life form reflects the life form spectrum of the community: 8 species are Hemikryptophyta, 1 a Hemikryptophyton-Geophyton, 2 Chamaephyta-Hemikryptophyta and 2 species Geophyta.

Our aim was on the one hand to become familiar with the dynamism of the shooting system of the species, and on the other hand to obtain informatory data — by judging on the basis of the chosen species — on what variability can be expected (in each layer resp. in the whole community) in the growth of the various species and in the growth characteristics. An estimation was attempted as regards the expectable of correspondence or shift in the time course of the growth parameter values in the cases of the different species within the community. In this study we offer the qualitative and quantitative (phenometrical) description of the development, the growth of the perennial individuals in *Brachypodium silvaticum* and *Euphorbia cyparissias*. In certain respect, the former species exhibits some relation with several other Gramineous species of the community, as regards the way of innovation of the perennial individual the growth rate, functioning and periodicity according to our investigations the latter species, exhibits a similarity to several dicotyledonous species in the habit examined; in this sense they can be considered also as more or less representative of the community.

Material and method

Brachypodium silvaticum and *Euphorbia cyparissias* were in general collected monthly in 1970 and 1971 (for the time of sampling see Figs 1 and 2, and Table V). Sampling was carried out in the identical site from the same population, and at different times. Occasionally, one stock of *Brachypodium silvaticum*, consisting of 30—50 shootings, and its polycormon were collected together with the related root-system (dug out to about 15 cm in depth); while 7—10 *Euphorbia cyparissias* individuals were lifted out with a perennial woody root-system. In the laboratory, the area of the leaves and other green parts was measured with optical planimeter (cf. MEDINA–LIETH, 1964), then, after drying at 80 °C the dry weight was determined. The data were calculated for one shout; in the values given in Fig. 1, also the root wright falling to one shoot is included. From these data, on the basis of BLACKMAN—WILSON (1951), BLACKMAN (1968), the relative growth rates (RGR) as well as the net assimilation rates (NAR) and the leaf area rates were calculated. In the case of *Brachypodium silvaticum*, the annual changes in these growth characteristics were related also to climatic factors: for this purpose, the data of the nearest meteorological measuring station (Budapest Observatory) were used so that the temperature and precipitation values averaged on the time intervals between the sampling times were calculated. Correlation calculation was carried out on the basis of SVÁB (1967). The external and internal effects on growth were estimated with the aid of path analysis (LEROY 1960, OSVÁTH 1961, PRÉCSÉNYI 1971).

Results and discussion

Brachypodium silvaticum

On the basis of the 1970 and 1971 observation is can be stated that height growth of the stocks consituting the vegetative unit is the most intensive at the beginning of May, however, the bottom fertile shoots of the preceding year are still on the stock. At the end of May the new shoots have 4—5 internodes and stem leaves, and at the same time newer young vegetative shoots appear at the bottom of the stock. The fertile shoots are recognizable by the

middle of June; their number amounts to about one-third of the total shoots. The lowest leaf sheaths together with the first stem leaves, however, are already drying. Despite the latter, it is at this time, that the differentiation in fertile shoots takes place, and that *Brachypodium silvaticum* produced the highest RGR and NAR values in 1970 (Table VI.). The growth in the fertile shoots reaches the maximum by the end of July (the stage of flowering), while that of the sterile shoots already earlier, in June. At this time the relative growth rate begins decreasing primarily because of the decline in NAR. By the end of August, the falling of the seed, the browning of the sterile shoots begin to become general, and also the first stem leaves of the fertile shoots are drying. Simultaneously with this, 10 new shoots on the average appear on the stocks so it is a start phase of the new stool. That is why the RGR is still positive at this time. It becomes negative in September (Table VI.), then the growth in the extravaginally produced new shoots is not able to counterbalance the loss caused by the falling of the seed. An even higher negative RGR is characteristic of the situation in October, when only the stem leaves of the fertile shoots that flowered in August and the numerous new shoots remain green. At the end of November, the stocks make a lifeless impression. At the same time, the color of the lower internodes of the once fertile shoots is still green with their covering brown sheaths cast off. One dismembered stock shows 1 fertile and 1—2 sterile shoots, constituting a unit with the related root system. Later on 6—7 new shoots originate from one such unit. The new shoots are bifoliate already in November—December. An important period of innovation in *Brachypodium silvaticum* is November—December—January. At the end of January, under the snow-cover, a part of the sterile shoots of the preceding year becomes destroyed together with the fertile shoots, though the lower stem parts of the latter are rather resistent, so the lower two internodes remain and even new shoot primordia start from the lower internodes. Their colour is light green, their content watersoluble. Owing to the unfavourable conditions of water uptake, the top of the young leaves dries. By the end of February, the death of a considerable part of the epigeous shoots has already set in. In the period passed since January the growth of the shoots that started after the seed was ripe continued, and concerning their development, they can be separated into 4 groups. At the end of March, the young shoots are 1—3 foliate. The stock consists of a mixture of dry and fresh shoots. It is at this time, or state, that the way of migration of a stock can be studied well. Within the stocks 3—4 cm long pieces of internodes of the preceding year can often be found. By this time they are already lying on the ground. On their apex new shoots and roots appear, and through this stem-part the new shoots, coming into existence on it, sustain connection with the old-stock until the following year. This is what guaranties the limited vegetative migration of the stock.

Within one stock the development and destruction of the shoots of different age determine jointly the growth of the whole stock as well as the values of its growth characteristics in each period.

As a first step for the evaluation of the relations between the growth characteristics the correlation coefficients were calculated on the basis of the data obtained during the two years of study. The correlation is the highest and significant between NAR and RGR, as could be anticipated on the basis of data in the literature related to Graminea species (EAGLES 1967, WILSON—COOPER 1969) (Table I). Then the question arose whether it was the internal factors of plant character, or the external environmental factors, that had the greater influence on growth? The experimental setting, known by some examples in literature (cf. KVĚT—ONDOK—NEČAS—JARVIS 1971), could not be produced, instead a correlation was calculated between growth characteristics, temperature, and precipitation values, respectively (see Material and method).

Table I

Semimatrix of the correlation coefficients of variables,
x_1 = *temperature,* x_2 = *moisture,* x_3 = *NAR,* x_4 = *LAR,* x_5 = *RGR,* $^{**}P = 1\%$

	x_2	x_3	x_4	x_5
x_1	.5822	.0689	.4493	.1634
x_2		.2889	.3405	.2578
x_3			—.1993	.7420**
x_4				.1243

It can be seen from Table I that the correlation of temperature and precipitation, respectively with all the growth characteristics is though positive, yet not significant. Path analysis to detect direct and indirect effects also showed the main influence of NAR (Tabl. II).

Table II

Path coefficients of the examined variables and the percentage rate of the various effects (for symbols see Table I)

Path coefficient		% effect
P_{15}	.0258	.07
P_{25}	—.1051	1.10
P_{35}	.8331	69.41
P_{45}	.3146	9.90
Direct together		80.48
Indirect		—17.05
Other		36.57

The direct effect of the environmental factors on the growth characteristics of the species is insignificant. It should be mentioned here that in 1971 PRÉCSÉNYI detected a correlation between climatic factors and changes in the productivity of communities. He also proved notable direct effects of certain factors by path analysis.

The correlation of the two climatic factors with the relative growth was evaluated also separately, by breaking down into factors (Tables III and IV.).

Table III

Breaking down of the correlation between temperature and RGR into its components

Temperature—RGR	r_{15}	.1634
Temperature directly	P_{15}	.0258
Through precipitation	$P_{25}r_{12}$	—.0619
Through NAR	$P_{35}r_{13}$	.0574
Through LAR	$P_{45}r_{14}$	.1413
	total	.1626

Table IV

Breaking down of the correlation between precipitation and RGR into its components

Precipitation—RGR	r_{25}	.2578
Precipitation directly	P_{25}	—.1051
Through temperature	$P_{15}r_{12}$	.0150
Through NAR	$P_{35}r_{23}$	.2407
Through LAR	$P_{45}r_{24}$	.1071
	Total	.2577

On the one hand it seems that the direct effect of precipitation is straight of a negative direction, and on the other hand that temperature exerts its effect on the growth of *Brachypodium silvaticum* rather through NAR. A newer path analysis directed at NAR the values of which are not published here, was also carried out. The result was that factors x_1, x_2, and x_4 contribute to the NAR variability by no more than 20%, for which assumably some other, internal, factors are responsible.

Euphorbia cyparissias

Flowering took 11 days between the end of April and the beginning of May. At its initial phase the primary inflorescence axes reached their whole length. The foliage and involucre leaves as well as the bracts of the fertile shoot are green. The Cyathium bending out of the cyme is vivid yellow. Later,

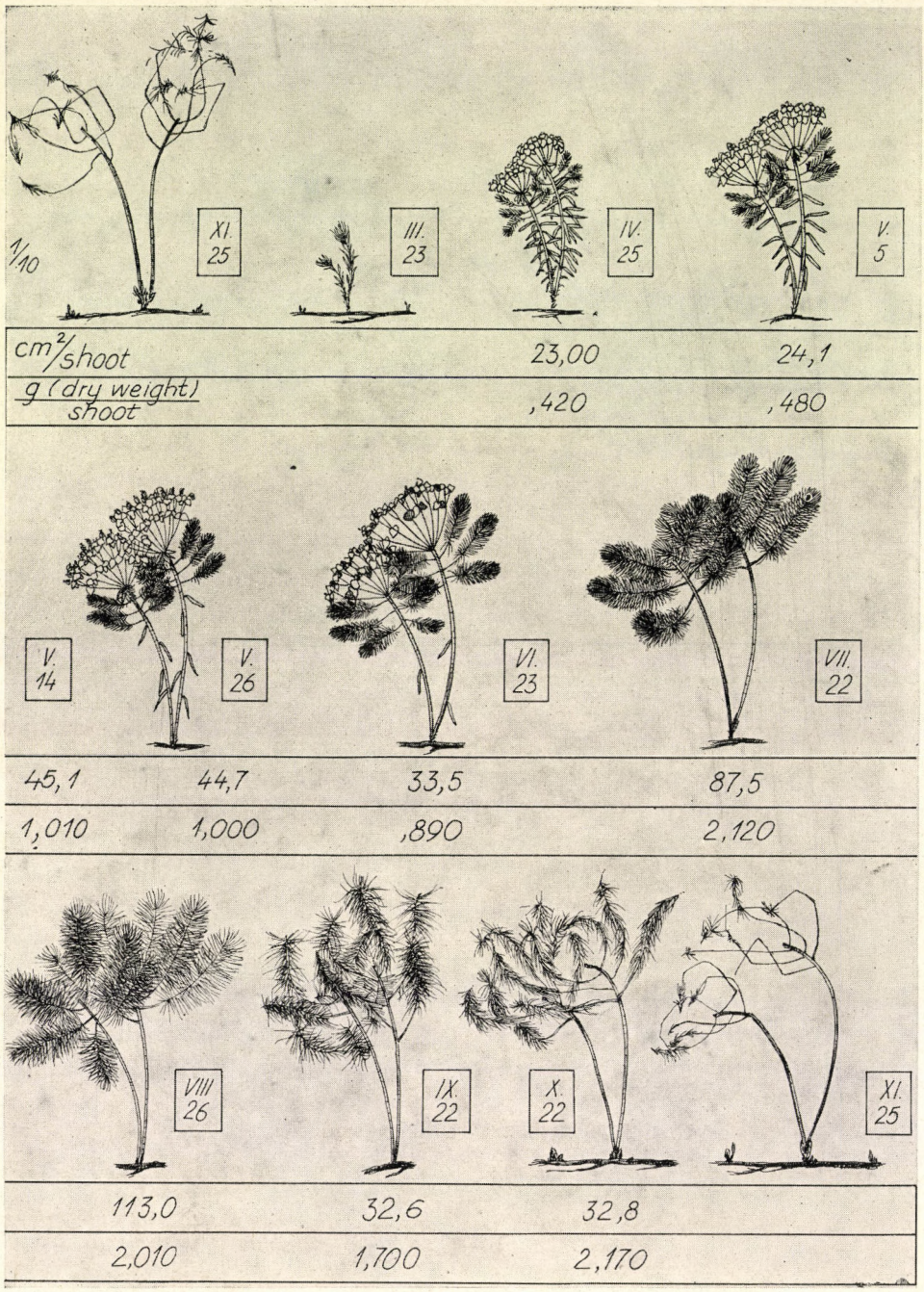

Fig. 1. Developmental dynamism of *Euphorbia cyparissias* in 1970 and 1971

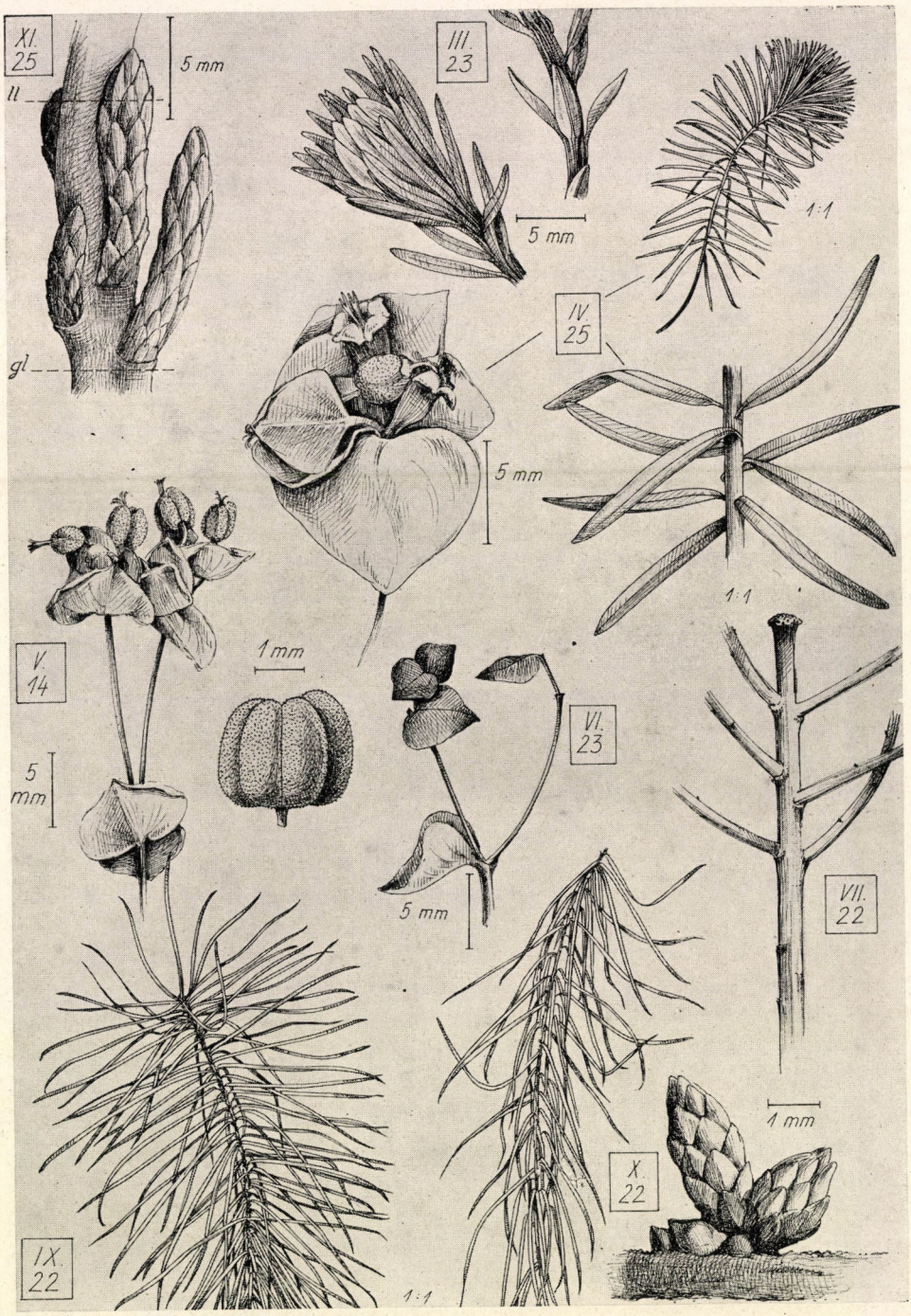

Fig. 2. Details of organs clearly indicating the various developmental phases. ll=litter layer; gl=ground or soil layer

the secondary inflorescence axes elongate. Below the cyme, small sterile side shoots run from the stem (see Figs 1, 2). By the middle of May, the secondary inflorescence axes are nearly thrice as long as they were at the time of flowering. The fruits are developed, green. The highest dry weight, and NAR and RGR values appear now, at the time of fructification (Table VI). This state was followed with an about 10-day delay by the formation of the greatest leaf area rate — LAR —, when, on the other hand, the net assimilation rate and the relative growth rate suddenly became of a negative sign. This direction of the growth characteristics suggests that at the period of maturity, the dehydrated nutrient substances accumulate in the ripening seeds, but parallel with this the growth of the sterile side shoots is also intensive, which may be accompanied by intensive respiration, and because of this the otherwise expectably high RGR values of a positive sign fail to occur. From the beginning of flowering till the fall of the seed about 2 months have passed. Simultaneously with defructuation, the inflorescence axes are discolouring, stem and involucre leaves are about to fall. The reduction in dry weight by shoots at the end of June may be related to these desorganisational phenomena. This process is still not counterbalanced by the further growing of the sterile side shoots. On the other hand, this latter process is reflected by the habitus of the plant, and by their characteristics in July. Among the elongated sterile shoots, the bracts of the substaining primary and secondary inflorescence still appear in vivid colours. The once fertile shoot now resembles a "comose tree" form. The assimilating area by side-shoots is more than double of the value in June, NAR and RGR again obtain a positive sign. By the end of August, the inflorescence axes have fallen down from the top of the fertile shoot, rarely only one—two dry stumps indicate its past existence (see Fig. 1).

On the fertile stem, the sterile side shoots developed during the summer produce the largest assimilating area. In August, the dry weight falling to one shoot decreased, thus the NAR and RGR values related to those in July became of a negative sign (Table VI).

The discolourization of the leaves of the comose tree-shaped plant begins in the middle of September, and some of the leaves are already falling. This process terminated by October, with the exception of the top leaves. At the same time, at several places on the root system of the perennial individuals new buds appear, most of them on the collar. (According to the data from the herbarium, innovation already began in September in other years). The simultaneous starting of innovation (at several places) on the subterranean part is reported also by RAUH (1936). The material- and energy-building activity of the large assimilating area developed after the completion of the reproductive period promotes the development of the buds (see Table V.). By November the steam axis dried away above the soil surface, but some of the buds appearing at the collar and more rarely on removed root parts

— some but by far not all — get to the soil surface but do not extend to above the litter. The leaves of these shoot primordia are pale green. In March of the year 1971, on top of the shoots standing the winter under the litter cover, the cyme primordium was already discoverable (see Fig. 1), while in the second half of April flowering began.

The reproduction period of *Euphorbia cyparissias* ends in June, or July the latest; innovation begins in September—October; in the winter this process is interrupted, since in the autumn the shoot primordia did not rise above the litter surface. During the period that passed from the completion of the reproductive period till the beginning of innovation, and even a little further, dry matter redeposition towards the parts could be observed (see Table V).

Table V

Percentage distribution in the dry weight per one shoot of Euphorbia cyparissias, between the supraterranean and subterranean plant parts, in 1970

Date	Supraterranean %	Subterranean %
VII. 22	88,62	10.38
VIII. 26	80.60	19.40
IX. 22	52.35	47.65

Comparison between the development and growth of the two species

Brachypodium silvaticum and *Euphorbia cyparissias* belong to the species of the *Orno-Quercetum* community which survive the winter with an assimilating surface (SZUJKÓ-LACZA—FEKETE 1973). By this property they are able to assimilate early in the vegetation period.

According to the data of Table V, the dry weight of the subterranean parts showed an increasing, while that of the supraterranean parts a decreasing tendency from July till September. In *Brachypodium silvaticum* the seed fell from the early-developed fertile shoots by the end of July, while from the later-developed ones in August and September; simultaneously with this, innovation could be observed on the roots; no signs of nutrient accumulation occurred. In favourable periods of winter, the young green shoots above the litter cover were able to photosynthetise.

In 1970, the NAR and RGR values of *Euphorbia cyparissias* showed top levels already in the middle of May; LAR followed them only at the end of the month (Table VI); this maximal leaf area ratio coincided with the period of seed ripening.

In comparison with the May 1970 data, LAR was low in 1971, while NAR showed a conspicuously high value, also in May. At that time the species was able to produce, with a relatively low rate of assimilating area, but with

Table VI

Changes in the growth characteristics in 1970—1971

	Brachypodium silvaticum			*Euphorbia cyparissias*		
Date	LAR	NAR	RGR	LAR	NAR	RGR
1970						
V 5	65.87	.0009	.0646	54.76	.0025	.1335
V 14				46.44	.0158	.7439
V 26				88.91	—.0002	—.0099
VI 23	62.38	.0028	.1760	41.37	—.0009	—.0388
VII 22	54.55	.0014	.0830	40.20	.0073	.3046
VIII 26	57.15	.0008	.0411	48.55	—.0005	—.0331
IX 22	59.70	—.0011	—.0774	39.24	—.0017	—.0558
X 22	46.82	—.0045	—.1941			
1971						
IV 21	29.23	.0074	.1557			
V 21	33.12	.0032	.1061	27.31	.0239	.6253
VI 10	83.84	.0040	.2676	25.35	.0003	.0087
VI 29	104.16	.0028	.2935			
VII 23	90.98	—.0027	—.2375			

a high photosynthetic activity, almost the same high RGR values as had been produced in the preceding year. Nevertheless, we can state in relation to both years that *Euphorbia* has a maximal relative growth rate when its NAR value is also the highest. This sets in in May.

With *Brachypodium silvaticum* the LAR maximum was at the beginning of May in 1970, while the NAR and RGR tops were in June, which coincided with the time of the reproductive period. In 1971, NAR reached its maximum already in April, while the highest values of LAR and RGR appeared jointly at the end of June. In June 1971 RGR exceeded up to two and a half times that of May — similarly as in 1970. Thus the species reached this maximal relative growth not in the same way in 1971 as in 1970; this year with a maximal NAR, while next year with maximal LAR. The behaviour of the two species' were completely contrary to each other in 1971. *Euphorbia* increased its photosynthetic activity related to 1 cm^2 to an extremely large extent, while *Brachypodium* increased the ratio of leaf area (Table VI).

After the NAR and RGR top values, both growth characteristics were of a negative sign in *Euphorbia* already at the end of May in 1970. At the end of July the sign again turned positive — probably attributable to the photosynthetic activity of the strong sterile side shoots — while in August and September the sign was again negative. These data suggest that the growth dynamism of the species is uneven.

The growth of *Brachypodium silvaticum* is much more even. In 1970, negative NAR and RGR values appeared only at the end of September. It seems that the intensive growth and development of the leaf area in June

1971 caused an early (June!) negative state of NAR, probably because of the rapid overwhelming of the respiration component (cf. WATSON—DAYASHI 1965).

Comparing the positive-signed NAR and RGR values of the two species in 1970 and 1971, we found that these values are higher in *Euphorbia cyparissias* than in *Brachypodium silvaticum*, for both years. The change in value and direction of the growth characteristics examined may be related occasionally to the phenophase of the species concerned, while in other cases to their varying physiological activity. GLAGOLEVA (1962) confirmed, on herbaceous plants growing at the higher altitudes of the alpine zone in Easterns Pamir, the periodicity in the photosynthetic activity of the various developmental and growth periods. Changes in NAR values may at the same time refer to periodicity, concerning respiration intensity as well.

These first examination in Hungary into development and growth carried out on populations grown in the same natural plant communities show that the two chosen species essentially differ from each other as regards their growth characteristics, and the time course of the values of the latter.

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DONNÉES CHIMIOTAXINOMIQUES SUR LES BORAGINACÉES

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On the basis of gas chromatographical examinations in *Boraginaceae* (40 species; 88 seed samples), the presence of gamma-linolene and octadekatetraene acid is characteristic with the exception of *Heliotropioideae*. Intraspecific differences were found with regard to both gamma-linolene acid (*Borago officinalis*), and tetraene acid (*Lapulla squarrosa*). The relegation of the genera *Alcanna*, *Asperugo* and *Caccinia* to the tribes *Anchuseae*, *Eritrichieae* and *Cynoglosseae* cannot be upheld. With its maximum unsaturated fatty acid content, the *Lithospermeae* differentiated the most from the primordial *Heliotropioideae*. As regards carbon chain lengthening (22 : 1) the deviation of *Cynoglossaeae* is maximum on the other hand. The rest of the taxa within the other families could be chemotaxonomically arranged with the points of reference of there three end products.

Le fait que l'acide alpha-linolénique est l'acide gras constituant principal des galactolipides dans les tissus photosynthétisants de toutes les plantes supérieures (JAMES et NICHOLS, 1966) et, de plus, que l'activité photosynthétique est liée à la présence de cet acide gras même chez les Algues vertes (KATAMAYA et BENSON, 1967) pendant que les acides linoliques sont incorporés dans les phospholipides, témoigne du contrôle des insaturations des acides gras dans les feuilles par des systèmes d'enzymes très fins, mais distincts (TRÉMOLIÈRES 1972). Ces systèmes d'enzymes agissent en premier lieu en conformité à leur détermination génétique, même que sous l'influence du milieu, et en dépendence de la phase de développement, comme ce fut démontré dans le rapport des acides gras insaturés — en premier lieu de l'acide alpha-linolénique dans les lignes autofécondées du maïs (PONELEIT et DAVIS, 1972). Une telle détermination génétique de la formation des acides gras insaturés assure une bonne base aux recherches biochimiques comparatives et à un traitement chimiotaxinomique et plus exact de la phylogenèse, comme il est manifesté par l'esquisse établie par NICHOLS (1970) sur les Algues:

Les cellules et feuilles photosynthétisantes, même si elles appartiennent aux différentes familles de Plantes, montrent de compositions caractéristiquement similaires de galacto- et phospholipides, par contre au fait bien connu que dans leurs graines la composition et ainsi l'accumulation des acides gras peuvent être très variées (NICHOLS et JAMES, 1968). Jusqu'ici on a observé quatre déviations de cette image, en général, uniforme: Les deux premières concernent des acides gras cyclopropénoïdiques des graines des Malycées

et Sterculiacées, — l'acide malvalique et l'acide sterculique — qui se trouvent aussi dans les feuilles de la plante. Le troisième cas est celui de l'acide xyménique qui se trouve dans les graines — et aussi dans la plante même — de certaines espèces des familles des Olacacées, et Santalacées. Cependant dans ces cas-ci, les recherches ont prouvé que la synthèse des acides gras ne déroule pas dans les chloroplastes.

La quatrième divergence — qui nous intéresse le plus — concerne la présence de l'acide gamma-linolénique et de l'acide octa-déca-tétraénique dans

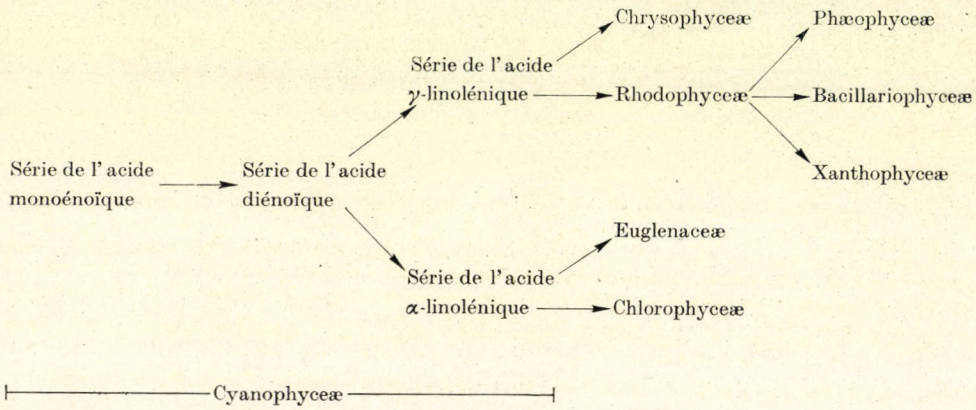

Fig. 1

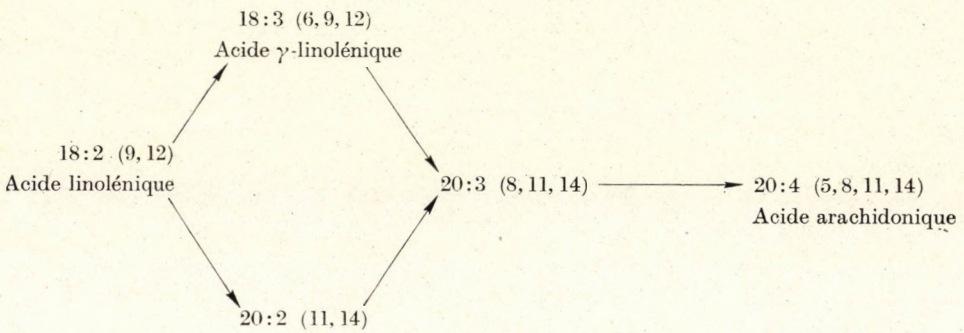

Fig. 2

les feuilles de Boraginacées, alors que ces acides gras sont aussi les substances caractéristiques des graines (JAMIESON et REID, 1969) (Fig. 1). La figure suivante montre d'ailleurs les deux voies biogénétiques possibles, conduisant aux acides tetraéniques que l'on a trouvé jusqu'ici (NICHOLS, 1970); la voie de l'acide gamma-linolénique caractérise les Plantes supérieures. (Fig 2).

Les acides gras insaturés jouent un rôle également important dans le régime hormonal des Animaux supérieurs et de l'Homme, puisque ils sont les pierres de construction des prostaglandines. Au commencement des recherches, à notre pays, sur les prostaglandines l'attention des chercheurs se dirigeait logiquement sur la présence des acides gras insaturés dans les plantes et l'Institut de Recherche des Plantes Médicinales se joignait à ces travaux. Nos recherches prenaient comme but l'investigation des espèces de Hongrie de la famille des Boraginacées, celles-ci étant découvertes déjà dans la littérature (MILLER et al., 1968). Dans ces essais, nous avons pris pour point de départ la plus récente étude phytogéographique de R. Soó, le Volume III de son manuel sur la Flore de Hongrie (1968), pour rechercher les espèces appartenant à cinq tribus (*Anchuseae*, *Cynoglosseae*, *Echieae*, *Eritrichieae* et *Lithospermeae*) de la sous-famille des *Boraginoideae* et à la famille des *Heliotropioideae*. Des 40 espèces de Hongrie figurant dans l'ouvrage de Soó, on a réussi à examiner 22 espèces, et de plus les deux plantes fourragères *Symphytum*, cité par lui et *Borago officinalis*. Par échange de graines entre les jardins botaniques et des plantes fructifiant à la station Budakalász de l'Institut, on a obtenu les graines de 15 espèces en plus. Le matériel des espèces spontanées intéressantes fut recueilli au cours des excursions.

Matériel et méthode

Extraction de l'huile: par un moulage des graines à poids connu, extraction dans un appareil Soxhlet avec de l'éther de pétrole pendant 8 heures et évaporation du solvant.

Préparation des acides gras: on a saponifié 4 à 5 grammes de l'huile en présence de KOH et d'éthanol, en faisant bouillir pendant une heure, réglant la valeur pH à 2, aménant à l'ébullition, refroidissant la solution et la secouant avec un solvant organique pour extraire les acides gras libres. Après lavage solvant organique au neutre avec de chlorure de sodium saturé et évaporation du solvant, on a obtenu les acides gras propres.

Préparation de l'ester d'acide gras: on ajoute de l'alcool absolu et de l'acide sulfurique concentré à la portion pesée de 200 à 250 grammes d'acide gras pour obtenir les esters éthyliques. L'extraction avec un mélange d'éther de pétrole et d'éther se fait en plusieurs portions par secousses; on élimine l'acide de la phase organique par lavage et l'évaporation du solvant fournit les esters d'acides gras qui se prêtent à la chromatographie gazeuse.

Par la chromatographie en couches minces, on n'a fait que quelques essais d'orientation; pour l'analyse qualitative et quantitative on se servait de la chromatographie en phase gazeuse. Les détails de ce méthode se trouvent dans un article antérieur (TÉTÉNYI et collaborateurs, 1973). L'évaluation qualitative se basait aux courbes graphiques et aux valeurs obtenues par l'intégrateur, à l'acide des étalons procurés par la firme Sigma et d'huiles végétales de compositions connues. Pour l'évaluation quantitative, sur la base des données obtenues par l'intégrateur, on se servait d'une méthode d'étalons internes.

Résultat et discussion

38 parmi les 40 espèces (88 échantillons) examinées de la famille de Boraginacées contiennent en quantités diverses de l'acide gamma-linolénique. Les exceptions suivantes méritent d'être retenues: 3 échantillons de *Helio-*

tropium marine et l'échantillon de *Heliotropium supinum* ne contenaient pas cet acide gras. Pour le *H. supinum* cela s'accorde à la littérature, mais par rapport à *H. marine* c'est une information nouvelle. D'après la littérature, *H. currasavicum* et *H. strigosum* ne contiennent pas ce triène non plus, pendant que dans l'échantillon de *H. amplexicaulae*, on a trouvé de 0,8 pourcent d'acide gamma-linolénique. Au cours de nos essais, nous avons détecté ce constituant, en quantités réduites dans *H. europaeum*.

Dans 32 échantillons, la proportion de l'acide gamma-linolénique est plus de 10%, ce qui est déjà une valeur significative. Les données caractéristiques des meilleures drogues sont récapitulées dans le Tableau 1. Dans la littérature, la valeur la plus élevée de teneur en acide gamma-linolénique est

Tableau 1

Espèce	acide γ-linolénique (%)	
	en acide gras	en drogue
Symphytum asperum Lepech.	28.1	3.37
Borago officinalis L. (cv. NDK 1.)	22.9	8.04
Symphytum orientale L.	22.2	3.79
Symphytum officinalis L.	20.9	4.91
Symphytum caucasicum Bieb.	20.1	3.80
Symphytum × *uplandicum* Nyman	19.6	6.01
Borago officinalis L. (sans NDK 1.)	19,0	5.62
Lithospermum officinale L.	18.3	4.02
Lithospermum purpureo-caeruleum L.	18,2	3.04
Anchusa officinalis L.	17.9	2.60
Anchusa riparia DC.	17.7	3.24
Lithospermum arvense L.	15.6	2.12
Lycopsis arvensis L.	14.3	0.88
Symphytum tuberosum L.	14.1	5.10
Asperugo procumbens L.	14,0	2.60

de 27% pour *Symphytum officinale* (KELIMAN et collaborateurs, 1964). On n'a pas trouvé de telles valeurs dans les deux échantillons examinés de cette espèce, mais le proche congénère, *S. asperum*, — non encore examiné — en contenait de plus.

Payez attention à la déviation, figurée dans le tableau, entre la moyenne des 5 échantillons de *Borago officinalis* et la variété de *B. officinalis*, provenant de la République Démocratique Allemande. Cette divergence rappelle que l'on peut détecter de différences chimiques infraspécifiques considérables, ce qui peut être d'importance du point de vue pratique.

Conformément aux données littéraires, nous avons retrouvé aussi l'acide octa-déca-tétraénique, au cours de nos recherches. Le Tableau 2. présente une liste des espèces intéressant à ce rapport. Quelques-uns de nos échantillons trouvés ont dépassé la valeur maximum dans la littérature (*Echium rubrum* a 15% de tetraène). Dans le cas d'une teneur élevée en acide tétraé-

Tableau 2

Espèce	acide octa-déca-tétraénique (%)		linolénique % tous les deux
	en acide gras	en drogue	
Lappula squarrosa (Retz.) DUM.	20.1	2.63	40.4
Lithospermum arvense L.	17.2	2.33	45.8
Lithospermum officinale L.	14.4	1.36	40.0
Lappula heteracantha Borb.	12.1	1.29	35.5
Lithospermum purpureo-caeruleum L.	11.9	1.98	45.6
Myosotis silvatica Hoffm.	10.2	4.64	39.5
Myosotis arvensis L. (Hill.)	8.9	1.74	26.9
Myosotis stricta Link.	8.8	0.95	27.4
Echium italicum L.	7.8	1.20	51.6
Lycopsis arvensis L.	7.7	0.51	18.1

nique, la présence de proportions considérables de deux acides linoléniques s'a avéré toujours, comme indiquée par le Tableau. D'après la littérature, les échantillons de graines d'*Echium vulgare* contenaient de proportions considérables (10%) en tétraène, quantité que l'on ne pouvait pas retrouver dans nos deux échantillons (1,5%, 1,7%); alors que nos données sur Lithospermum ont dépassé les données littéraires (10% et 7%). Nos données sur *Lappula*, *Myosotis* et *Lycopsis* sont nouvelles.

Les publications littéraires (MILLER et collaborateurs, 1968) sur les échantillons d'*Anchusa azurea* avec et sans teneur en tétraène font référence déjà aux divergences infraspécifiques, en dehors de nos données mentionnées ci-haut. D'après nos recherches un échantillon de *Lappula squarrosa* était privé d'acide tétraénique, et un autre ne contenait que 1,3% de cet acide gras, pendant que les teneurs des autres 5 échantillons se trouvaient entre 10 et 20,1%.

D'après les constatations morphologiques et de biologie de la floraison concernant les tribus de cette famille (GÜRKE, 1897), on doit séparer les *Cynoglosseae* épizoochores des *Erytrichieae*, pendant que le tribu de *Lithospermeae*, qui est pour la plupart anemomochore et autochore, doit être considéré comme séparé du tribu *Echieae* aux fleurs dorsoventrales. Le tribu mirmécochore *Anchuseae* est similairement séparé.

Le Tableau 3, se base sur les essais de composition des acides gras jusqu'ici effectués, en tenant compte des données littéraires. Le Tableau établit des groupes ayant trait au chimisme, qui cependant dans une certaine mesure s'accordent à l'image générale développée jusqu'ici, alors que dans une mesure plus réduite ils en diffèrent. D'après les données du Tableau 3. les *Heliotropioideae* sont les plus primitives, puisque elles ne contiennent pas d'acides gras plus insaturés que l'acide diénique 18 : 2 et leur longueur de chaîne H n'arrive pas à l'acide gras à C_{22}. Cette sous-famille est caractérisée par la formation maximale d'acide gras diénique 18 : 2. Un maximum similaire

Tableau 3

	pourcentage en acides gras					
	18 : 1	18 : 2	18 : 3	18 : 3	18 : 4	22 : 1
*Heliotropium europaeum** L.	34.9	28.8	0	0	0	0
*marine**	20.5	65.0	0	0	0	0
*supinum**	21.6	60.6	0	0	0	0
Heliotropioideae en moyenne	25.7	51.5	0	0	0	0
selon la littérature	21.8	61.8	1.3	0.2	0	0
Asperugo procumbens L.	28.6	38.4	0	14.0	0.1	0
*Anchusa officinalis** L.	23.3	33.4	13.7	15.2	0.7	1.3
procera Bess.	24.5	37.5	14.2	10.7	1.4	0
riparia DC	17.7	28.8	17.0	17.7	3.7	3.3
Borago officinalis *L.	20.3	36.2	2.9	20.0	2.5	0
Lycopsis arvensis L.	21.8	25.7	3.8	14.3	7.7	0
Pulmonaria mollissima Kern.	18.9	42.2	10.8	11.2	2.3	0
Symphytum asperum Lepech.	17.2	38.8	1.5	28.1	6.4	0.8
caucasicum Bieb.	24.5	38.4	2.6	20.1	1.4	1.6
*officinale** L.	23.4	41.2	0.1	19.4	0.1	0.8
orientale L.	27.0	38.1	1.6	22.2	0.1	0.9
tuberosum L.	31.9	31.2	0.1	14.1	0.1	0
**uplandicum* Nym.	28.1	37.9	2.1	19.6	0.3	0.9
Anchuseae en moyenne	23.5	35.8	5.3	15.5	2.1	0.8
selon la littérature	22.4	31.0	10.2	12.2	2.6	1.8
Caccinia strigosa Boiss.	38.5	16.7	34.6	0.5	0	0
Alkanna graeca Sprun.	19.2	27.9	34.2	7.8	0.1	0
orientalis (L.) Boiss.	15.5	26.0	33.0	12.0	3.3	0
Cerinthe minor L.	18.4	28.7	33.2	7.7	2.9	0
*Lithospermum arvense** L.	12.2	18.1	35.3	7.8	16.8	0
*officinale** L.	11.2	22.8	28.8	17.2	10.8	0
purpureo-caeruleum L.	11.7	20.4	27.4	18.2	11.9	0
*Myosotis alpestris** Schmidt	33.0	39.8	3.1	0.3	0.8	0
arvensis (L.) Hill.	26.1	25.9	23.3	3.6	8.9	0
*silvatica** *Hoffm.*	15.8	25.2	10.5	9.0	10.2	0
stricta Link in R. et Sch.	25.7	18.7	19.7	7.7	8.8	0
Onosma visianii Clem.	26.4	23.0	20.3	8.3	6.0	0
Lithospermeae en moyenne	20.1	28.1	23.9	9.9	8.5	0
selon la littérature	17.0	21.5	29.8	11.8	5.8	0
Echium italicum L.	16.4	12.6	51.0	0.6	7.8	0
*vulgare** L.	32.9	22.3	16.7	0.7	0.8	1.6
Echieae en moyenne	24.7	17.5	34.9	0.7	4.2	0.8
selon la littérature	12.0	19.0	25.5	12.0	12.5	0.5
Lappula deflexa (Wahlbg.) Garcke	43.1	28.8	6.1	8.6	0.1	0.7
heteracantha (Ledeb.) Borb.	19.5	18.5	28.3	7.2	12.1	0
*squarrosa** (Retz.) Dum.	26.8	20.1	26.0	4.8	10.7	1.4
Eritrichieae en moyenne	29.2	23.2	19.4	6.9	7.6	0.7
selon la littérature	21.6	23.0	22.6	8.6	7.0	0.9

Tableau 3 suite

	pourcentage en acides gras					
	18 : 1	18 : 2	18 : 3	18 : 3	18 : 4	22 : 1
*Cynoglossum amabile** Stapf. et Drum.	34.0	31.3	0.8	2.5	0	11.7
glochidiatum Wallich.	21.6	25.0	15.2	12.6	5.1	7.5
*hungaricum** Simk.	37.9	14.3	18.5	3.0	2.3	14.6
*officinale** L.	35.7	30.9	6.2	7.0	0.7	10.1
*Omphalodes linifolia** Moench.	36.1	23.8	10.2	4.8	2.0	5.7
Paracaryum coelestinum (Lindley) Voss.	31.4	28.4	3.0	11.8	1.0	9.3
Solenanthus appenninus Hohen	30.3	31.3	10.2	4.5	5.5	4.0
Cynoglosseae en moyenne	32.4	26.4	9.1	6.6	2.4	9.0
selon la littérature	41.2	20.0	8.1	5.3	1.4	5.6

* moyenne de plusieurs échantillons.
** Données de MILLER et al. 1968.

en diène 18 : 2 se montre aussi dans *Asperugo* et *Anchuseae*. Cependant ces deux derniers-ci sont encore caractérisés par une teneur maximale en acide gamma-linolénique et une teneur basse ou nulle en acide alfa-linolénique 18 : 3. *Asperugo* en addition ne contient aucun acide érucique 22 : 1. *Caccinia* et *Alkanna* sont similairement libres d'acide érucique, à teneurs maximales en acide alpha-linolénique 18 : 3 et de plus, les graines de *Caccinia* sont libres de l'acide tétraénique. Le maximum de l'acide tétraénique se trouve dans les *Lithospermeae*; les échantillons examinés contenaient en même temps de quantités maximales en acide alpha-linolénique 18 : 3 et peuvent être considérés ainsi comme proches congénères des deux genres mentionnées auparavant. Pareillement, ce tribu ne contient de l'acide érucique non plus. Les *Echieae*, par contre, contiennent de l'acide érucique, ensemble avec de teneurs maximales en acide alpha-linolénique 18 : 3 et d'acide tétraénique 18 : 4. Ici l'intérêt chimique est ce que le diène 18 : 2 est au minimum, ce qui caractérise évidemment les Boraginacées primitives. Les *Erithrichieae* contiennent de même de quantités maximales d'acide tétraénique 18 : 4, ensemble avec un minimum en acide gamma-linolénique 18 : 3, ce qui caractérise le chimisme. Enfin, le tribu des *Cynoglosseae* doit être considéré comme complètement dissemblable; il se laisse caractériser en premier lieu par sa teneur en acide monoénoïque, puisque il contienne les quantités maximales en acide érucique 18 : 1 et 22 : 1. Par contre, sa teneur en acide linolénique alpha et gamma est très réduite. D'après ce qui précède, un réexamen de la classification de Caccinia parmi les *Cynoglosseae*, d'*Alkanna* parmi les *Anchuseae* et d'*Asperugo* parmi les *Eritrichieae* semble nécessaire.

Alors que nous n'avons plus de trentaines données propres ou littéraires sur environ 100 genres des Boraginacées, l'esquisse suivante, présentant la

situation de la composition des acides gras, peut démontrer d'une manière approximative et provisoire les divergences chimiques dans la famille et peut former le point de départ d'examens futurs et la base d'une système chimiotaxinomique (Fig. 3).

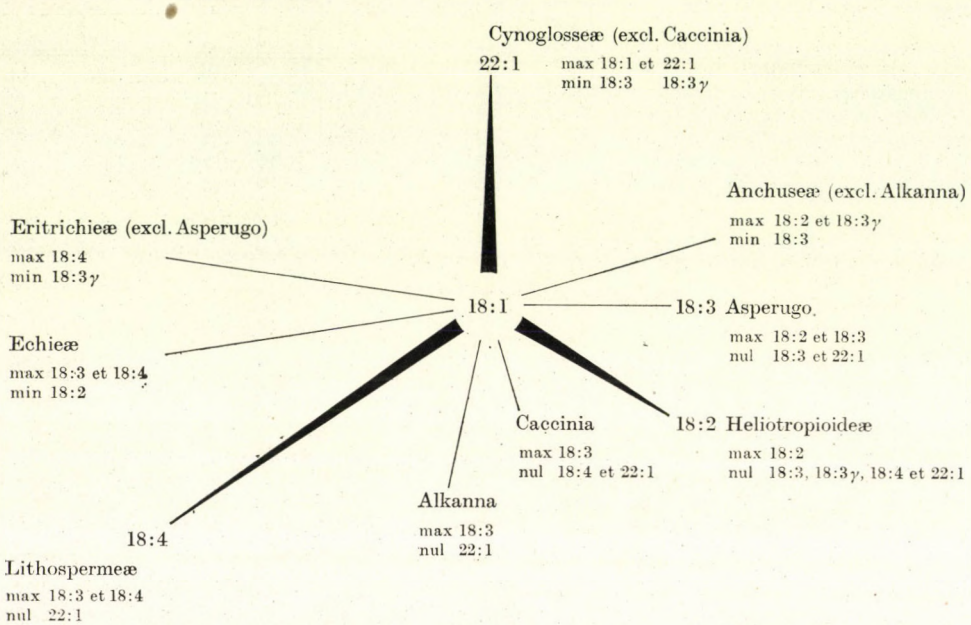

Fig. 3

Sommaire

Ayant examiné 88 échantillons de 40 espèces de la famille des Boraginacées, on peut tirer les conclusions suivantes à la base des données de chromatographie en phase gazeuse sur la composition des acides gras:

Les graines sont caractérisés par la présence de l'acide gamma-linolénique, à l'exception des échantillons de la sous-famille des Héliotropioïdées, dans 32 échantillons ce constituant formait plus 10% de la quantité d'acides gras. Les teneurs maximales se trouvaient dans *Symphytum asperum* Lepech. (28,1%) et la cultivar. I. de *Borago officinalis*, provenant de la République Démocratique Allemande (22,9%).

La présence d'acide octa-déca-tétraénique (18 : 4) était similairement caractéristique dans les échantillons examinés de cette famille. Les valeurs pour *Lappula squarrosa* (Retz.) Dum. (20,1%) et *Lithospermum arvense* L. (17,2%) sont en excès par rapport aux valeurs maximales de la littérature.

De différences infraspécifiques se produisaient par rapport à l'acide gamma-linolénique et l'acide tétraénique: dans 6 échantillons de *Borago*

officinalis et 7 échantillons de *Lappula squarrosa* on a observé des variations considérables en acides gras insaturés.

Enfin, on a comparé le système morphologique, employé jusqu'ici à l'intérieur de la famille, aux données à notre disposition sur la composition en acides gras des graines. Alors que les constatations existantes sur les relations peuvent être retenues en grandes lignes, quelques modifications dans le rangement des genres *Alkanna*, *Asperugo* et *Caccinia* se montrent nécessaires, puisque on ne peut pas les classer — comme antérieurement — dans les tribus *Anchuseae*, *Eritrichieae* et *Cynoglosseae*.

En considérant le chimisme, se présentant dans la composition des acides gras, la différentiation la plus remarquable par rapport aux Héliotropioïdées primitives se trouve dans le tribu *Lithospermeae* à valeurs maximales d'insaturation. Le tribu *Cynoglosseae* qui produit de quantités maximales d'acide érucique 22 : 1, en partant du monoène 18 : 1, par une élongation de la chaîne de carbone, montre une divergence dans une direction tout à fait différente. Les taxons dans la famille peuvent être rangés au point de vue de chimiotaxinomie, par rapport à ces deux points extrêmes et à la base de leur chimisme. Mon esquisse provisoire y relative est incorporée dans mon article.

J'ai l'obligation d'exprimer mes profonds remerciements au Dr. P. Kaposi, collaborateur scientifique en chef, pour la collection des plantes, et à Mme. I. Héthelyi collaboratrice scientifique, pour les analyses. Tous les deux sont chercheurs à l'Institut de Recherche des Plantes Médicinales. C'est avec plaisir que je fais mention de la collaboration à ce sujet que l'on a fait avec les collaborateurs scientifiques de l'Usine Pharmaceutique Chinoin, en premier lieu avec Dr. Z. Mészáros, Directeur adjoint pour la recherche et Dr. J. Szejtli, conseiller scientifique.

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ANGABEN ZUR NEUESTEN ZÖNOSYSTEMATISCHEN EINTEILUNG DES POLYGONION AVICULARIS BR.-BL. 31. I

Von

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Of the 8 weed associations belonging in the *Polygonion avicularis* Br. Bl. 3lst association group, and ocurring the author describes in the present study only one ruderal association, under the name *Euphorbio (supinae)-Polygonetum herniarietosum* Ubrizsy 55/72, recorded also in the Balkan (e. g. in Bulgaria) and in Italy. The association occurs with increasing frequency in the trodden wolks and slaggy footpaths, on the edges of pavements and roads in towns and cities, e.g. in Budapest since about 1950, while TIMÁR found in it Szeged already in 1946—1950.

The total species number of the association is 85; of these 61 species can be considered as bound to the association. The ecological and coenostructural characteristics of the association are as follows. Bio-oecological spectrum: Th: 65.7%; TH; 5.9; H: 25.5; G: 2.9%.

Floristic spectrum: Adv. 15.7%; Cosm.: 17.7; Cp.: 9.8; Eua.: 50.0; Eu.: 1.9 Medit. (Submedit.); 4.9%. Constitution spectrum: K5: 2.3%; K4: 7.0; K3: 8.2; K2: 26.0; K1: 56.5%.

Mit der detaillierten Verbreitung der sekundären Pioniergesellschaften, die in der ungarischen ruderalen Vegetation eine wesentliche Rolle spielen, mit ihren ökologischen und zönologischen Charakteristika und mir ihren hauptsächlich unter typisch ruderalen Verhältnissen sich abspielenden Sukzessionsvorgängen (sog. Kultursukzessionen) haben sich FELFÖLDY (1942, 1947), TIMÁR (1947, 1950, 1953, 1957), UBRIZSY (1949, 1950, 1955), FERENCZY (1957), TIMÁR—BODROGKÖZY (1959), T. SIMON (1957) und PRISZTER (1952) eingehend befasst, während eine zönosystematische Übersicht über die ganze Gruppe in zeitgemässer Form von Soó (1945, 1947, 1949, 1953, 1955, 1960, 1961, 1964) gegeben wurde. Diese Übersicht haben wir als Grundlage für unsere Untersuchungen angenommen. Vorweg müssen wir betonen, dass sich die Ausdehnung der anthropogenen Vegetation (der segetalen und ruderalen Vegetation insgesamt) nach dem zweiten Weltkrieg sprunghaft vergrössert und dass die Bedeutung der ruderalen Vegetation besonders wegen der fortschreitenden Urbanisierung weiter zugenommen hat. Dies lässt die intensivere Beschäftigung mit dieser Gruppe begründet erscheinen.

Es ist bezeichnend, dass aus der Reihe der ruderalen Pflanzengesellschaften in ganz Europa zunächst jene Gruppe den Gegenstand ausgedehnter Forschungen bildete, die das Begehen gut verträgt und somit auf devastierten Flächen zuerst erscheint, die also Kontaktgesellschaften mit ausgesprochenen

Pioniereigenschaften umfasst. Natürlich wurde ihre Assoziation auch am frühesten beschrieben. Die Gesellschaft *Lolium perenne-Plantago major* wurde von den österreichischen Botanikern VIERHAPPER und HANDEL-MAZETTI 1905 aus Österreich, von LINKOLA 1921 aus der Umgebung des Ladogasees und schliesslich von BEGER 1930 als *Lolium perenne-Plantago major*-Assoziation aus Berlin beschrieben. Dieselbe Gesellschaftsbezeichnung benutzte auch AICHINGER (1933), während unabhängig von den genannten Autoren TÜXEN (1937) eine Gesellschaft als *Lolium perenne-Matricaria suaveolens*-Assoziation beschrieb, die aus Prioritätsgründen später (TÜXEN 1950, SISSINGH 1950) mit der soeben genannten zusammengezogen werden musste; so entstand die erste, beschriebene ruderale Phytozönose *Plantagineto-Lolietum* Beger 30 oder genauer *Lolio-Plantaginetum majoris* (Linkola 21) Beger 30. Bahnbrechend waren auch die Untersuchungen von GAMS (1927) über die erstgenannte Assoziation (*Lolietum perennis*) und hauptsächlich über das *Polygonetum avicularis* welches in der ruderalen Sukzession der *Lolietum perennis*-Assoziation immer vorangeht. Nicht minder wichtig war aber seine Erkenntnis von der zönologischen Rolle und Bedeutung der nitrophilen Ruderalpflanzen auf viel begangenen Stellen. Die Benennung der Assoziations-Gruppe, ihre erste gründlichere Charakterisierung und Ergänzung durch weitere, hauptsächlich mediterrane (+ submediterrane) Gesellschaften ist das Verdienst von BRAUN-BLANQUET (1931, 1936), der die sekundären Pionier-Kontaktgesellschaften der begangenen Stellen unter dem Namen *Polygonion avicularis* Br.-Bl. 31 zusammenfasste.

Die weitere gründlichere Analyse dieser Gruppe wurde gleichzeitig von TÜXEN (1950) und SISSINGH (1950) durchgeführt, deren Mitteilungen über den Charakter bzw. über die typischen Artengruppen voneinander wesentlich abwichen, denn während die typische Artengruppe bei TÜXEN zu 60% aus Hemikryptophyton-Arten bestand, was, ökologisch betrachtet nicht ganz richtig ist, waren die charakteristischen Arten bei SISSINGH und auch bei anderen Forschern, dem zönotaxonomischen Charakter dieser Gruppe entsprechend, zu 87,5% Therophyton-Arten (einschliesslich der TH oder zweijährigen Hemitherophyton. Dies veranlasste neuerdings SISSINGH (1969) dazu, die bei Soó (1961, 1964) und TÜXEN (1950, 1955) noch einheitliche *Polygonion avicularis*-Assoziation-Verband in eine hauptsächlich aus Therophyten bestehende Gruppe *Polygono-Coronopion* (Br.-Bl. 31) Siss. 69 mit Pioniereigenschaften und in eine eher aus perennierenden Arten bestehende *Lolio-Plantaginion* Siss. 69 Verband aufzuteilen. Ihm folgen teilweise auch DOBRESCU—KOVÁCS (1972). SISSINGHS Auffassung ist nur teilweise begründet, da in Wirklichkeit zwischen den beiden Assoziationsgruppen (Verbanden) und ihre Mitgliedern kein so grosser Unterschied besteht, wie dies SISSINGH meint, und weil ein Teil der von ihm beschriebenen bzw. zusammengefassten Gesellschaften in Europa gar nicht existiert (z. B. die aus Japan von MIYAWAKI 1964 beschrie-

benen Gesellschaften (oder weil sie bloss Unterabteilungen (Subassoziationen, Fazies) bereits bekannter Gesellschaften darstellen, weil ferner einige Gesellschaften der *Lolio-Plantaginion*-Verband (wie z. B. die *Cichorium intybus* Ass. Tx. 41; die *Agropyron litorale-Cynodon dactylon* Ass. Br.-Bl. 36; die *Trifolium fragiferum-Arachnospermum canum* Ass. (Wagner 42) Tx. 50 usw.,

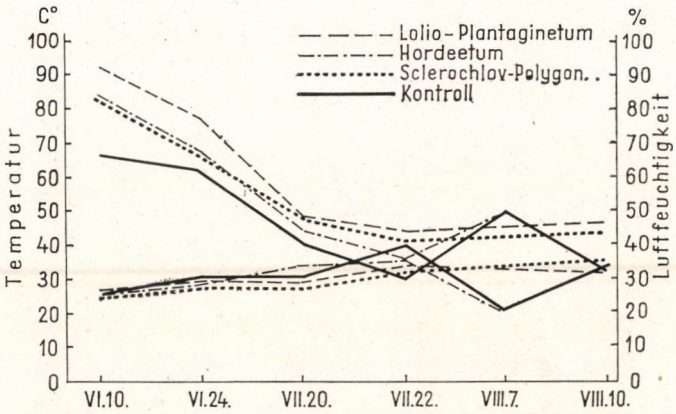

Abb. 1

nicht hierher gehören, vielmehr zusammen mit anderen Gesellschaften, die eine bereits höhere Stufe der Berasungsvorgänge darstellen, zur *Agropyro-Rumicion crispi* Nordh. 40 Ass. Verband gereiht werden müssen. Ich meinerseits halte die Einteilung Soós im seinem grossen floristisch-geobotanischen Werk (1964—1973) für richtig.

Unter Berücksichtigung der gründlichen Studie Sissinghs, der von ihm beschriebenen neuen Gesellschaften, ferner der zönotaxonomischen Übersichten von Braun-Blanquet (1936), Tüxen (1950), Oberdorfer (1957) und Soó (1961, 1964) sowie der von mir neuerdings in Ungarn gefundenen und sowohl floristisch als auch ökologisch eingehend untersuchten (s. Tab. 1 und Abb. 1) ruderalen Pionier-Phytozönosen schlage ich für die ruderalen Pionier-Gesellschaften auf viel begangenen Stellen folgende differenziertere Gruppierung vor:

PLANTAGINETEA MAJORIS Tx. et Prsg. 50

XXV. **PLANTAGINETALIA MAJORIS** Tx. (47) 50 (Syn.: *Potentillo-Polygonetalia avicularis* Tx. 47; *Potentilletalia anserinae* Oberd. 49)

1. **Polygonion avicularis** Br.-Bl. 31 (Sy.: *Poion annuae* Rübel 33; *Lolio-Arction* Knapp 45 p.p.; *Lolio-Potentillion anserinae* Tx. 47 p.p.; *Polygono-Coronopion* (Br.-Bl. 31) Siss. 69.)

Tabelle 1

Monolitun-

Gesellschaft	Ort und Zeit der Untersuchungen	Bestandshöhe cm	Mikroklima	
			Temperatur 13^h	Luftfeuchtigkeit 13^h
Kontroll	**Budapest**			
	1953. 6. 10	—	25.6	66.8
	1953. 6. 24		29.2	62.0
Sclerochloo-Polygonetum	Budapest			
	1953. 6. 10	6—8	26.0	82.4
	1953. 6. 24	10—14	29.1	66.8
Sclerochloo-Polygonetum	Szarvas			
	1949. 6. 18	8—10	30.3	55.3
	1949. 9. 18	12—16	23.2	86.0
Lolio-Plantaginetum	Budapest			
	1953. 6. 10	48—52	25.4	92.4
	1953. 6. 24	58—62	28.2	77.0
Lolio-Plantaginetum	Szarvas			
	1949. 6. 18	35—42	29.8	60.1
	1949. 9. 18	52—56	22.3	88.8
Poetum annuae	Budapest			
	1953. 6. 24	15—20	25.5	67.3
Poetum annuae	Szarvas			
	1949. 9. 18	24—32	22.1	86.8
Hordeetum murini	Budapest			
	1953. 6. 10	34—36	26.4	84.2
	1953. 6. 24	40—42	29.0	68.0
Hordeetum murini	Szarvas			
	1949. 6. 18	28—32	31.2	58.1
	1949. 9. 18	36—40	22.8	88.2
Atriplicetum tataricae	Budapest			
	1949. 6. 24	68—72	30.0	84.5
Atriplicetum tataricae	Szarvas			
	1949. 9. 18	82—86	23.5	90.8

1. *Sagino-Bryetum argentei* D. S. et W. 40. emend. Tx. 47.

— *spergularietosum* (*Spergularia rubra — Sagina procumbens* Ass. Tx. 47). Bei uns selten vorkommende Gesellschaft, deren Bearbeitung im Gange ist.

Myosuretum minimi (D.S. et W. 40) Tx. 50 (Syn.: *Myosurus minimus-Ranunculus sardous* Ass. Diem., Soss. et Westh. 40). Sein Vorkommen in Ungarn ist fraglich.

2. *Eragrostio-Polygonetum avicularis* Oberd. 52 (Syn.: *Panico-Eragrostidetum anagallidetosum* Tx. 50. p. p.): Wahrscheinlich gehört hierher die von PASSARGE (1957) beschriebene *Lepidium ruderale—Eragrostis poaeoides*-Ass., die er irrtümlich zum *Sysinbrion*-Verband gereiht hat. Die Bearbeitung für Ungarn ist im Gange.

3. *Amaranthus deflexus—Polygonum aviculare* Ass. Siss. 69. (Syn.: *Spergularia rubra—Amaranthus deflexus* Ass. Tx. et Oberd. 54.). Die Bearbeitung für Ungarn ist im Gange.

tersuchungen

Boden			Grünteile NA_3-N+NO_3-N auf 100 gr	Pflanzenmasse gr/200 cm²	Wurzelmasse gr/200 cm²
Bindungszahl	pH	Gesamt N im Boden v.H.			
35	7.32	0.16	—	—	—
36	7.7	0.19	1.86—2.36	3.82 24.62	0.72 9.5
39	8.16	0.23	2.3 —2.64	4.5 38.8	1.1 17.6
38	7.3	0.25	1.99—2.21	76.95 190.4	33.35 90.35
44	7.95	0.18	1.3 —1.82	68.2 169.2	30.1 56.3
38	7.6	0.22	—	—	—
43	8.2	0.23			
37	7.73	0.22	1.39—1.72	39.52 69.22	10.72 30.1
45	8.18	0.18	1.02—1.51	29.8 65.1	10.8 28.8
36	7.32	0.25	2.01—2.48	192.2	45.8
46	8.04	0.23	1.8 —2.2	224.3	62.7

Malva parviflora—Coronopus procumbens Ass. Tx. et Oberd. 54. Das Vorkommen in Ungarn ist fraglich.

4. *Sclerochloo—Polygonetum avicularis* (Gams 27) Soó (40) 45. [Syn.: *Polygonetum avicularis* Gams 27; *Sclerochloa dura—Coronopus procumbens* Ass. Br.-Bl. (31) 36 bzw. *Coronopo-Sclerochloetum durae* Br.-Bl. 36].

— *polygonetosum* (Pign. 53) Soó 61 (Syn.: *Sclerochloa-Coronopus* Ass. *polygonetosum avicularis* Pign. 53)
— *lepidietosum ruderalis* (Timár—Bodrogk. 59) Ubrizsy 69.
— *coronopetosum squamati* Soó (Syn.: *Sclerochloa-Coronopus* Ass. Br.-Bl. 31. p.p.)
— *euclidietosum* Timár—Bodrogk. 59. (Syn.: *Euclidietum syriaci* Slavn. 51)
— *amaranthetosum crispi* (Timár—Bodrogk. 59.) Ubrizsy 50.
— *spergularietosum salinae* Timár 57.
— *medicaginetosum lupulinae* Ubrizsy 49. Syn.:*Medicago lupulina* Ass. Felföldy 43).
— *lepidietosum drabae* Ubrizsy 49. (Syn.: *Lepidium draba-Sclerochloa dura* Ass. Ubrizsy 49.)
— *matricarietosum chamomillae* Ubrizsy 49.

Die ausführliche Bearbeitung dieser Gruppe für Mittel-Europa stammt von D. KORNECK (1969).

5. *Euphorbio (supinae)-Polygonetum herniarietosum* Ubrizsy (55) 72. [Syn.: *Digitario (sanguinalis)-Polygonetum avicularis euphorbietosum maculatae* Ubrizsy 55 n. n.;? *Herniaria glabra—Cardaminopsis arenosa* Ass. Kreh. 57. facies *Herniaria hirsuta, Linaria minor, Arenaria serpyllifolia, Eragrostis poaeoides.*]

— *herniarietosum (glabrae, hirsutae)* Ubrizsy 69.
— *oxadalietosum europaeae* Ubrizsy 69.

6. *Coronopo-Matricarietum matricaroidis* Siss. (66) 69.
— *typicum* Siss. 69.
— *lepidietosum ruderalis* Siss. 69.
— *coronopetosum squamati* Siss. 69. Die Bearbeitung dieser Assoziation für Ungarn ist im Gange.

7. *Poëtum annuae* Gams 27. [Syn.: *Lolium perenne-Poa annua* Ass. Aiching. 33; *Eragrostido-Poetum annuae* (Gams 27) Ubrizsy 72.]
— *plantaginosum majoris* Ubrizsy 1949.
— facies *Taraxacum officinale, Urtica urens, Sagina procumbens, Veronica hederifolia.*

8. *Lolio-Plantaginetum majoris* (Linkola 21) Beger 30 [Syn.: *Lolietum perennis* Gams 27; *Lolium perenne—Plantago major* Ass. Beger 30.; *Lolium perenne—Matricaria suaveolens* Ass. Tüxen 37.; *Lolietum perennis plantaginosum* Soó 47.; *Plantagineto-Lolietum* Ubrizsy 55, etc.]

— *typicum* Siss. 69; (Beger 30) Tx. 37.
— *cynodontetosum* (Timár 49) Ubrizsy 49 (*cynodontosum* Tx. 50.)
— *juncetosum compressi* Tx. (37) 50 (Syn.: *Lolieto-Juncetum compressi* Tx. 37.).
— *puccinellietosum distantis* Tx. 50.
— *festucetosum pratensis* Siss. 69.
— *ranunculetosum sardoui* Siss. 69.
— *achilleetosum collinae* Ubrizsy 49. (Syn.: *achilleetosum millefolii* Siss. 69.)
— facies *Glechoma hederaceum* Ubrizsy 49.; *Trifolium repens* facies oder Subassoziation Ubrizsy 49; *Poa compressa* facies oder Subassoziation Ubrizsy 49; *Convolvulus arvensis* facies Ubrizsy 49.

Plantagini-Juncetum macri (D. S. et W. 40) Oberd. 57. [Syn.: *Juncetum tenuis* (D. S. et W. 40) Schw. 44.] Das Vorkommen in Ungarn ist noch nicht geklärt.

Von den auch in Ungarn auftretenden 8 hierhergehörigen Unkrautgesellschaften werde ich in dieser Abhandlung nur diejenigen neuen ruderalen Assoziationen beschreiben, die ausser in Ungarn auch auf dem Balkan (z. B. Bulgarien) und in Italien aufgenommen wurden (s. Tab. 2).

5. Ass. *Euphorbio (supinae)—Polygonetum herniarietosum* Ubrizsy (55) 72 [Syn.: *Digitario(sanguinalis)-Polygonetum avicularis* Ubrizsy 1955 n. n. bzw.

— *euphorbietosum maculatae* Ubrizsy 1955.]

Es ist fraglich, ob die unter ähnlichen ökologischen Bedingungen, längs der begangenen Wegstrecken von Eisenbahnlinien (in) der BRD vorkommende Gesellschaft, die von W. KREH (1969) unter dem Namen *Herniaria glabra-Cardaminopsis arenosa* Kreh 57 beschrieben wurde, dieser ähnlich oder mit

Tabelle 2

Nr. der Aufnahme			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	K
Vegetationsbedeckung %			20–30	30–50	50–60	40	30	50	40–50	20–40	35–40	60	40–50	50–60	30–40	40	30–40	25–35	20–40	20–40	20–40	20–40	20–30	20–40	40–60	20–30	30–60	40–50	30–40	Stetigkeit
Kennarten:																														
Th.	Kozm.	*Polygonum aviculare*	1–2	+–1	2–3	+–1	+–1	+–1	+–1	1	+	+	–		–	2	2–3	1	1–2	1–2	1	+–1	+–1	+–1	1–2	+–1	2	3	+–1	5
Th.	Medit.	*Sclrochla dura*	–	–	–	–	–	–	+–1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	2
Differenzialarten:																														
Th.	Adv.	*Euphorbia supina*	1	1–2	1–2	–	1	2	–	+–1	–	–	–	–	–	–	1–2	1–2	1–2	2	1–2	1–2	–	1	+	–	–	–	–	4
Th.	Eua.	*Herniaria glabra*	–	–	–	–	–	–	2–3	1–2	1–2	2	2	2	2	–	–	–	–	2–3	–	–	2–3	–	–	–	–	–	–	3
Th.-TH	Eua.	*H. hirsuta*	–	3	–	3	2–3	+	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Verbandskennarten:																														
Th.	Cp.	*Hordeum murinum*	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	–	1
Th.	Eua.	*Lepidium ruderale*	–	–	–	–	–	–	+	–	+	+	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–	–	–	2
Th.	Adv.	*Matricaria matricarioides*	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1
Th.	Eua.	*Plantago maior*	–	2–3	+–1	2–3	1	2	1	1	1	1	1	+–1	+	+–1	+–1	2	+	1–2	1	1	+–1	–	–	–	–	1	–	–	4
Th.-TH.	Kozm.	*Poa annua*	–	–	+	+–1	+	–	1–2	+–1	1	2–3	+–1	+	–	+–1	+–1	–	–	–	–	+	+	+–1	+	–	–	–	–	1–2	4
Ordnungs- und Klassekennarten:																														
G	Cp.	*Agropyron repens*	–	+–1	–	–	–	–	–	+	–	–	+	+	+	–	+–1	+	–	–	–	–	–	–	–	–	–	–	2–3	2
Th.	Adv.	*Amaranthus crispus*	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	–	–	–	–	–	–	–	–	–	–	–	–	1
Th.	Kozm.	*Eragrostis pilosa*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1	1	1–2	1–2	–	–	–	–	1	–	–	3
Th.	Cp.	*E. poaeoides*	+	+–1	2–3	+	+	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	–	+	–	–	–	–	4
H	Eua	*Lolium perenne*	+	+	+	+–1	1	–	+	+	1–2	1	+	2–3	3	–	+	–	+	–	–	–	–	–	–	–	–	–	–	
Cheeopodiatea-Arten:																														
Th	Kozm.	*Capsella bursapastoris*	–	–	–	–	–	–	–	–	–	–	+	+	+	+–1	–	–	–	–	–	+	+–1	–	–	+	–	1–2	+	2
H	Eua	*Cichorium intybus*	–	–	+	+	–	–	–	+	+	–	–	–	–	–	–	–	+	+	+	–	–	+–1	–	–	+	–	–	–	3
Th	Adv.	*Erigeron canadensis*	+	+–1	+–1	1	+	–	–	+	–	–	–	–	–	+	+–1	+	–	+	–	–	–	–	–	–	+	–	–	2
Th	Eua	*Chenopodium album*	+	–	+	+	–	–	–	+	–	–	–	–	–	–	+	+	–	+	–	–	–	+–1	–	+	+–1	–	+	3
Th–TH	Cp.	*Stellaria media*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	1
egleiteBr:																														
Th.	Adv.	*Amaranthus albus*	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+–1	–	+–1	+	–	–	–	–	1	–	–	2
Th.	Medit.	*A. deflexus*	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1
Th.	Adv.	*A. retroflexus*	+	+–1	+–1	+	–	–	–	+	–	–	–	+	+	+	–	+	+	+	+	–	–	+–1	–	–	+	–	–	3
Th.	Kozm.	*A. lividus*	–	–	+	–	–	–	–	+	–	–	–	–	–	–	–	–	+	–	–	–	–	+–1	–	–	–	–	–	2
Th.	Adv.	*Ambrosia elatior*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	–	+	2
Th.	Eu.	*Arctium minus*	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	1
Th.	Eua.	*Art.misia annua*	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1
H.	Cp.	*A. vulgaris*	–	–	–	+	–	–	+	+	+–1	+	–	–	+	–	+	–	+	–	–	–	–	–	–	–	–	–	+–1	2
Th.	Eua	*Atriplex tatarica*	+	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	3–4	–	+–1	–	+	3
H–Ch.	Sub.-Medit.	*Ballota nigra*	–	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	2
Th.	Eua	*Bromus mollis*	–	+	–	–	–	–	1	–	+–1	+	–	+–1	+–1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Th.	Eua	*B. sterilis*	–	–	–	–	–	–	+	–	+–1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
H.	Kozm.	*Convolvulus arvensis*	–	–	–	–	–	+	–	+–1	+	+	–	+–1	–	+	+–1	+	+	+	–	+	–	–	+	–	+	–	+	4
Th.	Adv.	*Cuscuta campestris*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	–	–	–	–	1
G	Kozm.	*Cynodon dactylon*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	+–1	–	–	–	–	+–1	1	+	–	+–1	–	2
TH	Eua	*Daucus carota*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	+	–	–	1
Th	Kozm.	*Digitaria sanguinalis*	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	1	+	+–1	+–1	1–2	–	1	–	–	1	–	+–1	3
Th-TH.	Medit.	*Diplotaxis muralis*	+–1	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	1
Th.	Kozm.	*Echinochloa crus-galli*	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	1
Th.	Adv.	*Galinsoga parviflora*	–	+–1	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–	2
TH.	Eua.-M.	*Lactuca serriola*	–	+	–	+	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	1
H.	Eua.	*Lotus corniculatus*	–	+	–	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
Th.	Eua.	*Matricaria chamomilla*	–	–	–	–	–	–	–	–	+	+–1	+	+–1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	+–1	2
Th.-TH.	Eua	*M. inodora*	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	1
Th.	Eua.	*Medicago lupulina*	+	–	–	+–1	+	+	–	–	–	–	–	–	–	–	+	–	+	–	–	–	+	–	–	–	–	–	–	2
Th.	Eua.	*M. minima*	–	+	–	–	–	–	–	–	+–1	+	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	2
Th.	Eua.	*Melilotus officinalis*	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
H.(G)	Medit.	*Oxalis europaea*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+–1	–	–	+	+	–	1	–	–	–	–	–	2
H.	Eua.	*Plantago lanceolata*	–	–	–	–	–	–	+	–	+	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
G.	Cp.	*Poa angustifolia*	–	–	–	–	–	–	+	+	+	+	+	+–1	+	+	–	–	–	–	–	–	–	–	–	–	–	–	+	2
Th.	Kozm.	*Portulaca oleracea*	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	+	–	+–1	–	+	1–2	–	–	2
H.	Eua	*Potentilla reptans*	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1
Th.	Kozm.	*Setaria verticillata*	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	1
Th.	Eua.	*S. viridis*	–	–	–	+	+	–	–	–	–	–	–	–	–	–	+	–	+–1	+	+	–	–	+	+–1	–	+–1	–	–	2
Th.	Eua.	*Sinapis arvensis*	–	–	–	–	–	–	+	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	+	–	–	–	1
Th.	Eua.	*Sonchus oleraceus*	–	+	–	+	+	–	–	–	–	–	–	–	+	+	+	+	–	+	–	+	–	–	+	–	+	–	–	3
H.	Eua.	*Taraxacum officinale*	+–1	+	+	+–1	+–1	–	+	+	+–1	+	+–1	+	+	+–1	+–1	+	+	+	+	+	–	–	+	+	+	+–1	–	5
Th.	Eua	*Thlaspi arvense*	–	–	–	–	–	–	9	–	–	–	–	–	–	–	–	–	+–1	–	–	–	–	–	–	–	–	–	–	1
Th.	Kozm.	*Tragus racemosus*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1–2	–	+	–	–	–	–	–	–	–	–	–	–	1
H.	Eua	*Trifolium repens*	+	+–1	+–1	1	+–1	2–3	+–1	+–1	+	+–1	+	1	+	+	+–1	+	–	–	–	–	–	–	–	–	–	–	–	4

Zufällige Arten: ad No. 1. Aufnahme: Th. Eua *Chenopodium striatum* +; ad No. 2. H. Adv. *Solidago serotina* +, Th-TH. Eua. *Trifolium campestre* +; ad No. 5. H. Eua. *Achillea collina* +, Th. Eua. *Solanum nigrum* +; ad No. 7. Th. Eua. *Bromus tectorum* +–1. H. Eua. *Lepidium draba* +; ad No. 9. Th. Cp. *Polygonum lapathifolium* +; ad No. 13. Th. Eua. *Adonis aestivalis* +, H. Eua. *Rumex crispus* +; ad No. 14. Th. Adv. *Mirabilis annua* +; ad No. 15. H. Eu *Poa compressa* +, Th-TH. Eua *Sisymbrium orientale* +; ad No. 16. Th. Kozm. *Anagallis arvensis* +; ad No. 18. Th. Adv. *Pharbitis coerulea* +; ad No. 22. Th. Adv. *Elunine indica* +–1; ad No. 23. Th. Eua. Polygonum *hydropiper* +; ad No. 26. Th. Eua. *Cannabis ruderalis* +, Th. Eua. *Sisymbrium sophia* +; ad No. 27. Th. Cp. *Atriplex patula* +, Th. Eua. *Chenopodium glaucum* +–1, Th. Eua *Ch. urbicum* +, Th. Eua. *Malva neglecta* +–1, H. Eua. *Urtica dioica* +, Th. Eua.*U. urens* +–1.

Standort und Ze tpunkt der Aufnahme: No. 1. Budapest Donaustrand, 23. 9. 1950.; No. 2., 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Budapest, Margareten-Park No 2. 6. 8. 1966, No. 3. 4. 5. 6. 28. 8. 1966, No 7. 17. 5. 1967., No. 8. 28. 7. 1967., No. 9., 10. 14. 6. 1968., No. 11., 12. 13.: 21.5 . 1969., No. 14: 20. 9. 1969. No. 16., 18., 19. Budapest. Rosenhügel Ervinstrasse: No. 16.: 16. 9. 1970.; No. 18.: 22. 8. 1971., No. 19.: 12. 7. 1972.; No. 15. : 17, 20, 25, Budapest Rosenhügel, Herman Otto Str. No 15.: 27. 7. 1970.; No. 17.: 29. 7. 1971.; No. 20.: 14. 7. 1972., No. 25.: 22. 8. 1971.; No. 21., Plovdiv (Bulgaria) 8. 6. 1972.; No. 22.: Verona 19. 9. 1972.; No. 23.: Murano 22. 9. 1972.; 6o. 24. Bp. Stadtpark 9. 6. 1968.; No 26. Szigetszentmiklós 29. 5. 1970. No. 27. Baracska 26. 6. 1972.

ihr identisch ist. Die KREHsche Assoziation trägt eher atlantischen Charakter, und grösstenteils unterscheidet sie sich auch in ihrer floristischen Zusammensetzung von der ungarischen bzw. südeuropäischen submediterranen Gesellschaft. Ebensowenig lässt sich mit ihr die von A. MIYAWAKI aus dem Stadtgebiet von Yokohama beschriebene *Euphorbia supina—E. maculata*-Gesellschaft identifizieren, bei der es sich um eine ausgesprochen ozeanische Assoziation handelt, wenngleich ihre Funktion die gleiche ist wie die der Trittgesellschaft in Ungarn.

Diese Gesellschaft kommt übrigens hauptsächlich auf urbanisierten Stellen, auf dem betretenen Strassenpflaster der Städte, auf deren schlackigen Gehwegen, an den Strassen- und Gesteigerändern, auf schrotterbestreuten oder mit Quadersteinen gepflasterten Gehwegen immer häufiger vor, so z. B. in Budapest seit 1950 oder in Szeged, wo TIMÁR diesen Typ bereits 1946/50 entdeckt und als *Euphorbia maculata*-Facies der *Polygonetum avicularis* Assoziation beschrieben hat. In dieser Facies kommen aber die *Herniaria*-Arten (*Herniaria glabra* und *H. hirsuta*) nicht vor (TIMÁR 1950). Die *Euphorbia supina* (= *maculata*) ist eine konstant-dominante Art dieser Assoziation, manchmal kann sie aber auch fehlen. Allmählich hat sie sich als adventive Art in ganz Ungarn verbreitet. Ihre Einschleppung und ihre Verbreitung hat TIMÁR in seiner erwähnten Abhandlung ausführlich beschrieben, und hier beziehe ich mich auf ihn. Diese Art kommt auf dem Balkan (in Bulgarien) und auch in Italien (Venedig, Murano, Verona usw.) häufig vor und erscheint ausschliesslich in dieser Assoziation. In ihrer Form und Lebensweise, in ihren ökologischen Ansprüchen und in ihrer Resistenz gegenüber dem Begehen ähnelt sie weitgehend dem *Polygonum aviculare*, und ihre an den Boden angeschmiegte morphologische Haltung macht sie vorzüglich geeignet in den Zonationen an Strassenrändern (Kontakt-Pflanzengesellschaften) selbst die extremsten ökologischen Einflüsse (Begehen, Niedertreten, Störungen, Umbruch, Stickstoff-Verunreinigung usw.) zu ertragen.

Da die *Herniaria*-Arten zum grössten Teil eine ähnliche morphologische Haltung aufweisen und auch die Begehung ziemlich gut tolerieren, ist es verständlich, dass sie als Apophyton-Mitglieder der ungarischen Urvegetation in den primären Kontaktgesellschaften und so hauptsächlich in den oben genannten Gesellschaften der begangenen Stadtstrassen erscheinen. Die immer einjährige *Herniaria glabra* kommt öfter vor, doch findet sich auch die *Herniaria hirsuta* mit Th-TH-Charakter, wobei die beiden Arten seltener gleichzeitig auftreten. Häufig ist das gemeinsame Vorkommen mit *Euphorbia supina*, obwohl diese in vielen Fällen fehlen kann, und nur die *Herniaria*-Arten in der Gesellschaft vertreten sind. Während auf Dorfstrassen und auf sandigen oder tonigen Feldwegen das typische *Sclerochloo-Polygetum* bzw. einer seiner Typen erscheint (UBRIZSY 1949, 1950, 1955, 1968) und *Euphorbio-Polygonetum herniarietosum* nie anzutreffen ist, erscheint dieses auf den gepflasterten Strassen der Städte, auf den

Spazierwegen von Parkanlagen, an trockenen, sonnigen, warmen Stellen stets als sekundäre Initialgesellschaft neben den *Sclerochloo-Poygonetum* oder nebeneinander anderen Phytozönose (z. B. neben dem *Sclerochloo-Polygonetum avicularis* usw.). Ausser dem *Herniaria*-s Typ ist für diese Gesellschaft auch die Subassoziation *Oxalis europaea* (= *stricta*) charakteristisch die an manchen Stellen des Rosenhügels in Budapest z. B. in der Ervin Gasse schon seit Jahren regelmässig vorkommt.

Die Gesellschaft umfasst insgesamt 85 Arten, von denen 61 als an die Gesellschaft gebunden bezeichnet werden können; während die anderen Arten nur zufällig vorkommen, oder am Rande des relativ grossen Verbreitungsgebietes der submediterranen Phytozönose in Erscheinung treten (wie z. B. die *Eleusine indica*, die hauptsächlich in Italien auftritt, die ich aber auch auf einem Standort in Budapest gefunden habe. Die ökologischen und zönostrukturellen Kennwerte dieser Gesellschaft sind die folgenden:

Bio-ökologischen Spektrum: Th: 65,7%; TH: 5,9; H: 25,5; G: 2,9%.

Floristisches Spektrum: Adv.: 15,7% Kosm.: 17,7; Cp: 9,8; Eua: 50,0; Eu.: 1,9; Medit. (submedit.): 4,9%.

Konstitutionsspektrum: K5; 2,3%; K4: 7,0; K3: 8,2; K2: 26,0; K1: 56,5%.

Typisch für die Phytozönose ist die Tatsache dass sie eher auf lockeren, sandigen, oder mässig bindigen Böden auftritt, dass aber die *Herniaria glabra* eher auf kalkhaltig-neutralen, die *H. hirsuta* hingegen auf kalkfreien-neutralen Böden zu finden ist. PRISZTER (1947, 1951, 1956) hat sie auf den Überschwemmungsgebiet des Szamos auf Schwemmland als Apophyton (Klausenburg) bzw. auf Ruinenboden (Budapest, Vérmező) und neuerdings auch die *H. hirsuta* auf mässig saurem, ausgelaugtem Boden in segetalen Gesellschaften als Stoppelaspekt in der Gegend des Cserhát-Gebirge gefunden. Die einjährigen Arten dominieren deren Wachstum später einsetzt als das des typischen *Sclerochloo-Polygonetum* (aufgrund 22jähriger Beobachtung beginnt das Keimen und die Entwicklung der *Sclerochloa dura* bzw. *Polygonum aviculare* je nach dem Jahrgang und dem Frühlingsanfang um den 18. III.—30. III.—21. IV., denn die *Euphorbia supina* als mediterrane Pflanzenart und auch die *Herniaria*-Arten fangen erst im Mai und Juni zu keimen und zu wachsen an. Ihre vegetative Entwicklung hört aber auch früher auf, wenngleich sie selbst bis Ende Oktober anhalten kann. Typische Aspekte hat diese Gesellschaft wie *Sclerochloa—Polygonetum* nicht bzw. sind sie nicht charakteristisch. (Immerhin sind z. B. *Sclerochloa dura-Coronopus squamatus* (= *procumbens*). *Poa bulbosa* et ssp. *crispa*, *Euclidium syriacum* typisch vernale Aspekte, während der *Amaranthus crispus* ein typischer ästivaler Aspekt ist.)

Diese Gesellschaft habe ich schon vor einiger Zeit gefunden, u. zu eben aufgrund der Mitteilung von TIMÁR (1950), nach der diese in Szeged sowohl

auf sandigen als auch auf bindigen sandigen Lehmböden vorkommt. Anhand der konstanten dominanten Arten habe ich sie mit dem Namen *Digitario (sanguinalis)-Polygonetum avicularis euphorbietosum maculatae* Ubrizsy 1955 bezeichnet, ohne dass ich diese charakteristische Phytozönose ausführlich hätte beschreiben können. Andererseits habe ich die Vorkommen in Budapest, Rózsadomb (Rosenhügel), am Donau-Ufer, im Stadtpark usw. seit 1950 ständig beobachtet und, nachdem ich sie auch mit ausländischen Vorkommen vergleichen konnte, habe ich begonnen sie ausführlich zu beschreiben.

OBERDORFER (1957) berichtete in seinem zusammenfassenden Werk über die süddeutschen Pflanzengesellschaften von einer neuen Pioniergesellschaft *Eragrostido-Polygonetum* Oberd. 52, als deren differenzierende Charakterart er die *Euphorbia supina* (= *maculata*) betrachtet. In dieser Gesellschaft sind neben den *Eragrostis poaeoides* (= *minor*) gerade die *Digitaria* (*Panicum*) *sanguinalis*- und die *D. ischaemum*-Arten die typischen. Da in dieser Gesellschaft auch der in Ungarn unbekannte *Coronopus didymus* vorkommt, kann man sie nur teilweise mit der von uns beschriebenen vergleichen. Jedenfalls verdient es Beachtung, dass die Art *Euphorbia supina* unter den in Westeuropa beschriebenen, zur *Polygonion*-Gruppe gehörigen Gesellschaften nur in dieser Phytozönose — unter gleichen ökologischen Bedingungen erscheint. Nach meinen Beobachtungen kommt diese Gesellschaft auch in Ungarn vor, ich habe sie oft aufgenommen, ihre Bearbeitung zusammen mit anderen Gesellschaften der Gruppe *Polygonion* wird die Aufgabe weiterer Publikationen sein.

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GENOME ANALYSIS OF THE EUROPEAN CYSTOPTERIS FRAGILIS COMPLEX

I. Tetraploid taxa

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The analyses of meiotic cells in synthesized hybrids and plants produced by induced apogamy show that 4x *C. fragilis* and 4x *C. dickieana* are allotetraploids, and have no common genome with *C. protrusa* (2x). *C. fragilis* 4x has built in also into the hexaploid *C. fragilis* and *C. regia*. One of its genomes is common also with *C. dickieana* 4x. Thus, with respect to the origin of the two tetraploids, 3 unknown diploids are assumed. The spontaneous somatic polyploidization of 2x *C. fragilis*, obtained by apogamy, demonstrates the origin of 4x *C. fragilis*.

Introduction

Cytopteris fragilis complex is one of the most complicated fern taxa. Both on a morphological and cytological basis it can be broken down into at least 6—7 gamodemes each one being isolated perfectly or nearly so. Morphologically the complex can be grouped on the basis of the shape of the frond, ending of veins and of the spore pattern. In Europe, within the complex, *C. fragilis* s. str. (L.) Bernh., *C. regia* (L.) Desv., and *C. diaphana* (Weath.) Blasdell represent the spiny spore type, while *C. dickieana* R. Sim the verrucose spore pattern. The separation of the three taxa with spiny spores — especially *C. fragilis* and *C. diaphana* — is very difficult, therefore, because of the numerous transitional forms, a subspecific rank of the latter (*C. fragilis* ssp. *diaphana*) is probably more correct.

"*Diaphana*" types in Europe are restricted to the Mediterranean territories. In addition to their morphological characteristics (veins ending in the apical notch of emarginate teeth) their seasonal growth rhythm is also different, which is sustained also in culture.

Distinguishing between *C. fragilis* s. str. and *C. regia* (*alpina*), with the latter having finely dissected fronds and characteristic emarginate teeth, usually does not mean any problem, but the *C. fragilis* x *regia* hybrids, frequent in nature, have the appearance of transitions.

It is known on a cytological basis, (MANTON 1950, SORSA 1961, 1962, WAGNER and HAGENAH 1956, MANTON and REICHSTEIN 1965, and BLASDELL

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1963), that the majority of the previously mentioned taxa exist on several ploidy levels built upon the $x = 42$ basic number:

C. diaphana	(2x)[1]	—	6x[2]	—
C. fragilis		4x	6x	8x[3]
C. dickieana		4x	6x	
C. regia			6x	
C. protrusa[4]	2x			

[1] BLASDELL's (1963) data from Chile
[2] MANTON, LOVIS and VIDA (ined.) — Madeira; VIDA (unpubl.) Portugal
[3] REICHSTEIN and VIDA (ined.) — the Alps. and Carpathians.
[4] North America only

Within these taxa, the morphological separation of the individual cytotypes is the most difficult between *C. fragilis* 4x and 6x. Contrary to the opinion of HAGENAH (1961) and BLASDELL (1963), spore size does not always lend reliable support to cytotype determination not even in the case of measuring a great number (more than 100) of spores (see also BIR 1967) — therefore, their taxonomical differentiation is not justifiable.

On the results of genome analyses of the *C. fragilis* complex continued for several years, only abstract drafts have been published (VIDA 1970, 1972). In Europe, the complete lack of the diploid level, and the existence of the high octoploid level, indicate that we are dealing with a rather old polyploid complex.

As a first step to analyse this difficult complex, we began to study the simpler, tetraploid taxa (*C. fragilis* s. str. 4x and *C. dickieana* 4x).

Materials and method

In order to get a better knowledge of the European *C. fragilis* complex, plants have been collected and cytologically analysed from more than 150 populations so far. The results will be published elsewhere (REICHSTEIN and VIDA). The origins of the plants discussed in the present paper are as follows:

C. fragilis s. str. 4x (Fig. 2)
C. 13 — Hungary, Bükk Mountain: Szarvaskő, leg. GV. 14th July, 1961
C. 39 — Hungary, Mátra Mountain: Sombokor, leg. GV. 2nd June, 1965
C. 72 — Poland, Ojców near Cracow, ex Hortus Bot. Cracoviensis 1965
C. fragilis s. str. 6x (Fig. 3)
C. 47 — Austria, Kitzbühel, Hahnenkamm, 1900, m leg. GV. 15th Aug. 1965
C. fragilis s. str. 5x hybrid (Fig. 4)
C. 40 — Great Britain, Derbyshire: The Winnats, Castleton, 350 m, leg. GV. 29 th July 1964
C. fragilis x *regia* 5x hybrid (Fig. 5)
C. 60 — Roumania, Retezat Mountain: Iorgovan, 1750 m, leg. GV. 11th Aug. 1968
C. dickieana s. str. 4x
AS-62 — Great Britain, Aberdeen (locus classicus), leg. A. Sleep
C. protrusa 2x (Fig. 1)
TR-880 USA, Appalachian Mountains, leg. D. J. HAGENAH (cultivated in Basel by T. REICHSTEIN)

For the hybridisation technics see LOVIS (1968). Acetocarmine squash preparations were made according to MANTON (1950). The method of inducing apogamy was identical with that of MANTON (1950), and MANTON and WALKER (1954).

Results

a. Wild hybrids

Although the ecological requirements of the tetra- and hexaploid *C. fragilis* are slightly different, in some places these two cytotypes can grow together. At these places pentaploid hybrids are not infrequent. The meiosis of the 5x hybrid is not too informative on the origin of the tetraploid taxon.

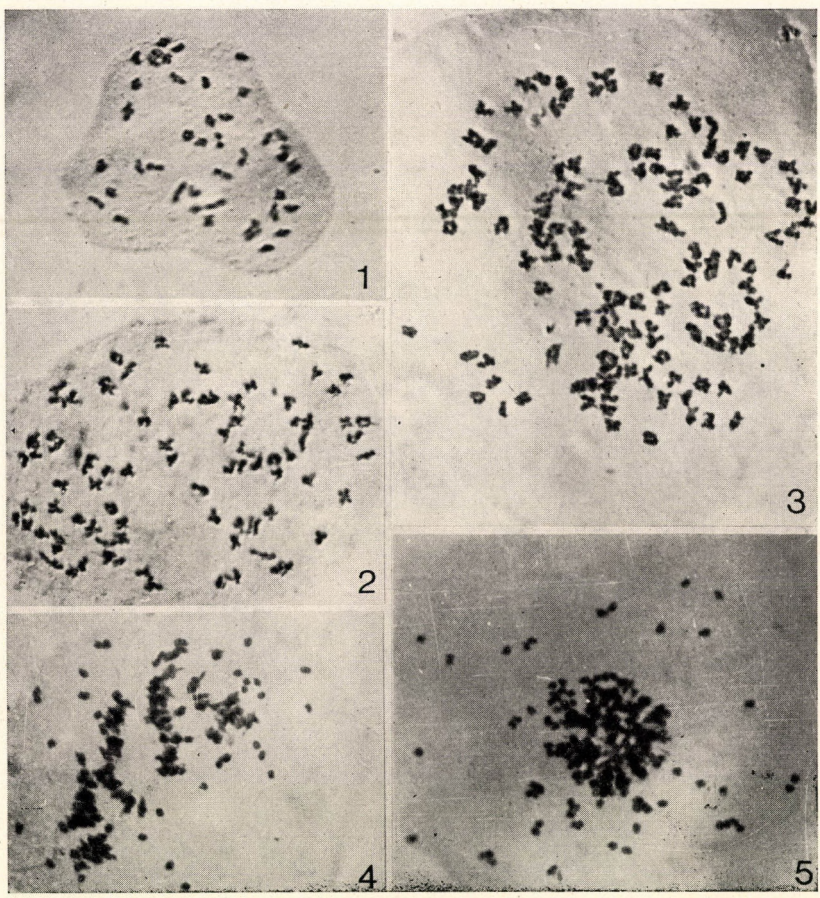


Plate I

Figs 1—5. Meiosis of *Cystopteris* species and wild hybrids (×1000). *1. C. protrusa* (TR-880) n = 42; *2. C. fragilis* 4x (C. 39) n = 84; *3. C. fragilis* 6x (C. 47) n = 126; *4. C. fragilis* 5x wild hybrid (C 40) n = C. $76_{II} + 58_{I}$; *5. C. fragilis* x *regia* 5x wild hybrid (C 60) n = c.$2x_{II} + x_{I}$

The c. 84 bivalents and c. 42 univalents ($2x_{II} + x_{I}$) merely indicate that one of the progenitors of the hexaploid cytotype might be the tetraploid *C. fragilis* (Fig. 4).

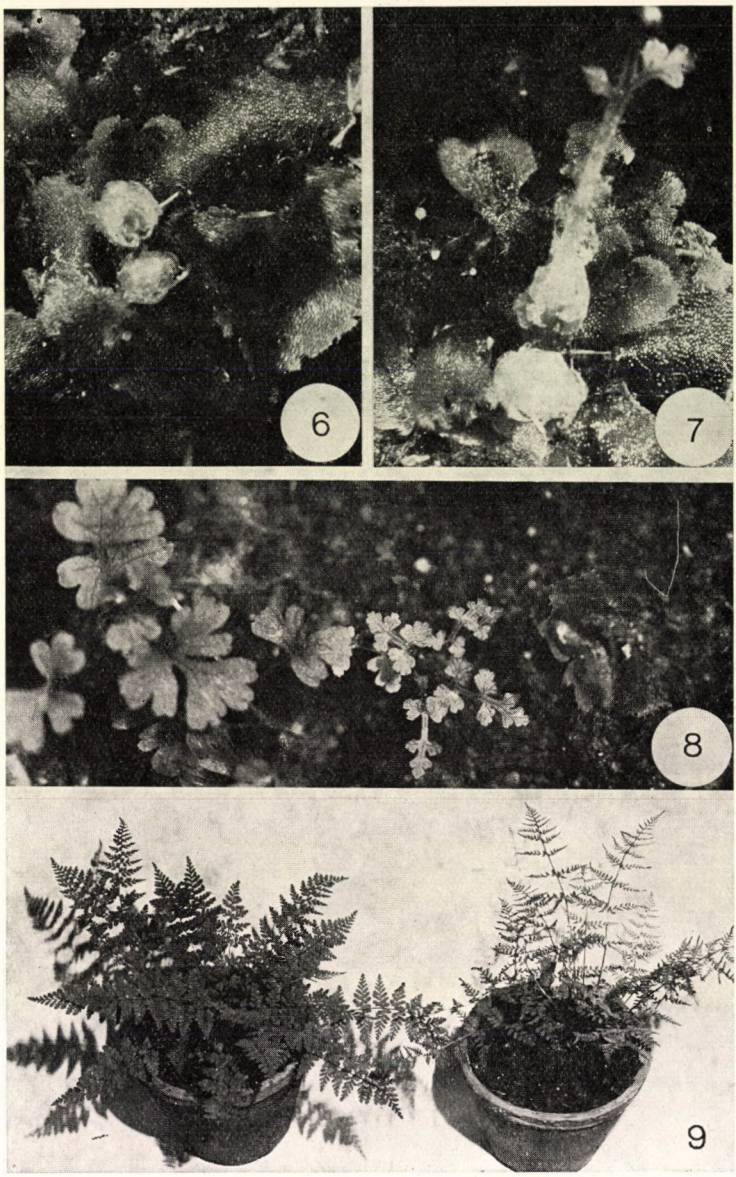


Plate II

Figs 6—9. Induction of apogamy in the tetraploid *C. fragilis* (C. 39). *6.* Apogamous outgrowths covered with scales in the prothallium culture (×10); *7.* Frond differentiating from one of the outgrowths (×10); *8.* Apogamous 2x (right), and sexual 4x plants (left margin) of the same age; magn. ×4; *9.* Adult 4x sexual (left) and 2x apogamous plants (right)

Among the *C. regia* x *C. fragilis* hybrids so far only the pentaploid combination (*C. regia* 6x x *C. fragilis* 4x) gave analysable cells. The proportion of bivalents in this hybrid is somewhat smaller (50—70) than in the former pentaploid. It is probably, therefore, that in *C. fragilis* and *C. regia* at least one, but possible 2 genomes are identical (Fig. 5).

b. 2x C. fragilis produced artificially

As no information on the genome composition of the tetraploid *C. fragilis* was obtained on the basis of the above wild hybrids, the production of sporophyte without fertilization was attempted on the reduced (in the present

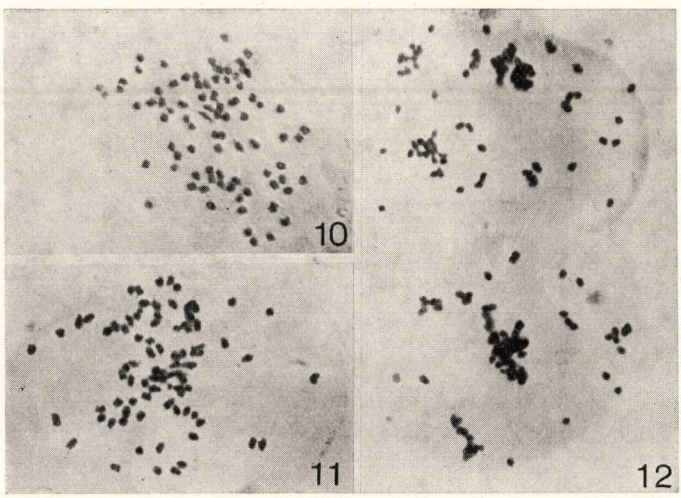


Plate III

Fig. 10—12. Meiosis of *Cystopteris fragilis* produced by induced apogamy (×1000). *10—12* Meiosis of a diploid produced from *C. fragilis* 4x (C. 13); 10: $n = 6_{II} + 72_{I}$, 11: $n = 8_{II} + + 68_{I}$; *12.* Meiosis of an induced apogamous diploid of *C. fragilis* 4x (C. 39) in two spore mother cells. The majority of chromosomes are univalents, accompanied by some bivalents (c. 6--12)

case diploid) gametophytic ploidy level. For this purpose, the spores of the tetraploid *C. fragilis* collected from 12 Hungarian localities were sown, then the young prothallia were pricked out further apart. The pots were watered merely from below, in order to prevent sexual fertilization. Because of the occasional condensation vapour this could not be fully achieved, but even so, enough gametophytes were maintained. After two years several apogamous outgrowths appeared almost synchronously in two spore cultures (C. 13 and C. 39). They were densely covered with scales (Fig. 6). The first fronds were also soon to develop (Fig. 7.). The pinnation of these was

more pronounced than of those developed sexually (Fig. 8). Most of these plants died after one-two months, as no root developed on them. However some of the apogamous plants, from both cultures (C. 13, C. 39), continued to grow, and reached the spore producing age as well (Fig. 9). From the other 10 spore sowings not even a single apogamous plant developed. This phenomenon suggests that the possibility of inducing apogamy is controlled by genetic factors.

The meiosis of the induced apogamous plants is rather irregular. Out of the 84 chromosomes on the reduced ploidy level, only 3—12 bivalents are formed, the rest remain univalent (Figs 10—12). On the basis of this pairing behaviour it seems probably that the tetraploid *C. fragilis* is of alloploid origin. It is also assumable that the two previously homologous genomes gradually diverged at the tetraploid level by chromosome rearrangements. This is, however less likely, since the structure of the small fern chromosomes is a rather conservative one. This has been proven by numerous allotetraploid x diploid hybrids still showing x pairs at meiosis in spite of the long genetic separation.

c. Synthetic hybrids

For the identification of the diploid progenitor, the diploids of *C. fragilis* complex outside Europe were also considered. The nearest related diploid is *C. protrusa* (BLASDELL 1963) now living in the eastern part of North America. By crossing this species with the European *C. fragilis* 4x, we obtained a triploid hybrid (C. 39 x TR-880). There were no essentially more bivalents in the meiosis of the hybrid than in the former diploid plant produced by induced apogamy. It was 13—15 bivalents and 100—96 univalents that could most frequently be observed in the first meiotic metaphase (Figs 13—14). The genome of *C. protrusa* is thus not identical with any of the unknown genomes of the tetraploid *C. fragilis*.

The situation is to some extent different in the case of hybridization between hexaploid *C. fragilis* and *C. protrusa* (C. 47 x TR-880). In this tetraploid hybrid at least 40 bivalents are formed, therefore, it is possible that the genome of *C. protrusa* has become built in the hexaploid *C. fragilis*. It is also assumable that the 6x *C. fragilis* is auto-allohexaploid, and that autosyndetic bivalents are present in the hybrid. In this case, trivalents could also be formed in the pentaploid *C. fragilis*. On the basis of our cytological preparations, however their presence cannot be either excluded or confirmed. As regards the genome composition of 6x *C. fragilis*, more convincing evidences are expected from the meiosis of plants with reduced chromosome set (3x) which have also been successfully induced by apogamy but not yet grown up to fertility.

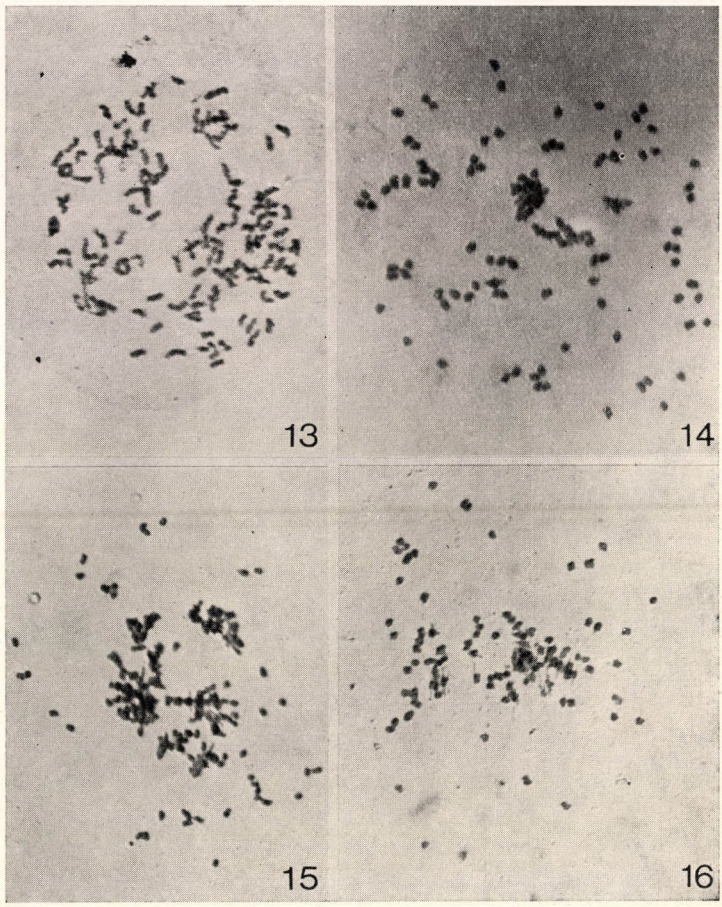


Plate IV

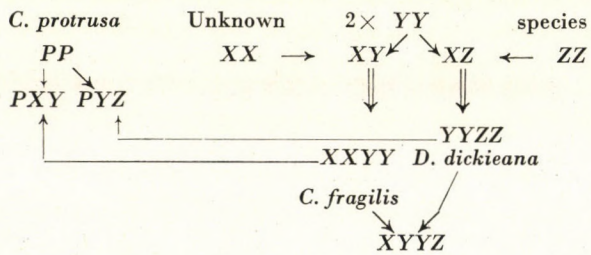
Figs 13—16. Meiosis of synthetic *Cystopteris* hybrids (×1000). *13.* Diakinesis of *C. fragilis* 4x (C. 39) × *C. protrusa* (TR-880), $n = 18_{II} + 90_I$; *14.* The same plant at metaphase I of the meiosis, $n = 12_{II} + 102_I$; *15. C. fragilis* 4x (C. 72) × *C. dickieana* (AS-62) tetraploid hybrid, $n = 54_{II} + 60_I$; *16. C. dickieana* (AS. 62) × *C. protrusa* (TR-880) triploid hybrid, $n = 18_{II} + 90_I$

Another member of the *Cystopteris fragilis* complex known also at the tetraploid level is *C. dickieana*. Although an unambiguous assignment of the taxonomical rank of this plant has not been aimed at in the present study, it is worth mentioning that we have never seen transitional types of the spore pattern (BLASDELL 1963). It is also exceptional that the morphological characteristics of the frond occur in overlapping with those of *C. fragilis* s. str. The sterility of the synthetic hybrid (*C. fragilis* 4x x *C. dickieana* 4x) presented here also indicates that the two 4x taxa are well isolated.

The tetraploid *C. dickieana* (AS-62) collected from the "locus classicus" has been attempted to cross with *C. fragilis* 4x of various origins. Among them

the combination of C. 72 x AS-62 was successful. In the meiosis of the hybrid 54 bivalents and 60 univalents were observed in several cells (Fig. 15). This indicates that the parental species share a common genome, provided that *C. dickieana* cannot form bivalents autosyndetically. For the clarification of this, we hybridized also this species with the diploid *C. protrusa* the genom of which presumably not closely related. The meiotic chromosome-pairing of the AS-62 x TR-880 triploid hybrid entirely corresponded with that of the *C. fragilis* 4x x *C. protrusa* triploid (Fig. 16). In other words, *C. dickieana* 4x is also allotetraploid and genomically not related to *C. protrusa*. As the hybrid of the two tetraploids (*C. fragilis* and *C. dickieana*) is unable to produce fertile progenies, and the chromosomes of the two taxa have also proved to be different, the same genome symbol cannot be applied to them. However, as has been mentioned, in addition to the one common genome justifying the formation of maximum 42 bivalents, 12 additional bivalents (54 altogether) developed. Similarly 12 paired chromosomes were also observed in the 2x *C. fragilis* produced by apogamy. This bivalent surplus thus can be explained by assuming that the other two genomes present in the *C. fragilis* x *C. dickieana* hybrid are also closely related.

The data obtained so far on genome analyses are summarized in the sketch below:



It is remarkable, (which at the same time suggests that the polyploid complex is very old), that for the explanation of the origin of two tetraploids already three presumably extinct taxa are sought, and as will be seen later (VIDA in preparation), the hexaploid level needs the genome of additional diploid species. It is possible therefore that the few tetra- and hexaploid species of today are the remnants merged into polyploids of a *Cystopteris* genus, once much richer in species.

d. Origin of the tetraploid level

By making the allotetraploid origin of the 4x *C. fragilis* fairly likely, the 2x plant produced by induced apogamy can be interpreted as a diploid hybrid prototype of the *C. fragilis*. From this sterile hybrid (formed between unknown diploid species X and Y), by doubling the chromosome set, the fertile alloploid

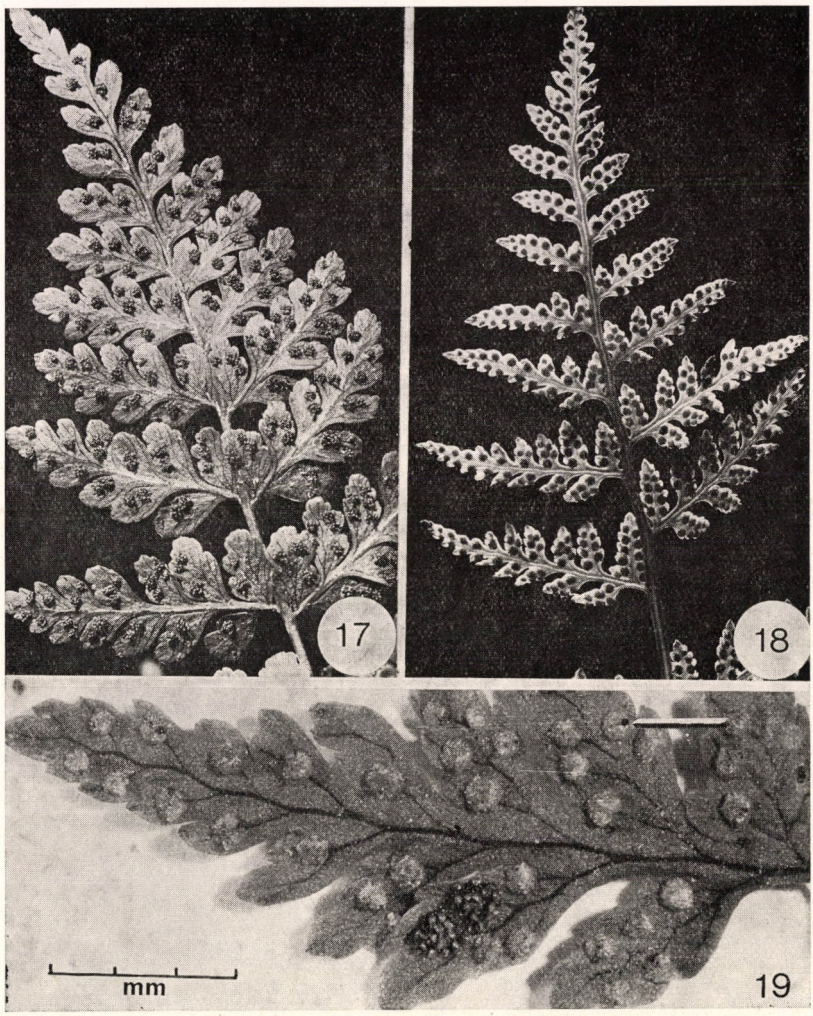


Plate V

Fig. 17. A part of frond of the tetraploid normal plant.
Fig. 18. A part of frond of the diploid plant produced by induced apogamy. The pinnae and pinnules of the frond are considerably narrower in the diploid.
Fig. 19. Pinna of the induced apogamous 2x plant. In a small area of the pinna somatic polyploidisation occurred, which is indicated by the two well developed sori. Sometimes polyploidy is restricted to a single sporangium

(XXYY) may have originated. One possible way of this process could be observed also in one of the diploid plants produced by us.

As it is conspicuous in Figs 17—18, the ratios between frond blade area and frond perimeter with 2x and 4x (normal) plants are considerably different. The pinnulae of the diploid frond are much narrower. When examining several 2x fronds more closely, we noticed that various pinnae or pinnulae of the frond

Plate VI

Fig. 20. Part of the pinna that has undergone polyploidization, in 2x *C. fragilis* (C. 39). The blade is wider on the tetraploid part, its sori contain normal sporangia with viable spores, capable to produce 4x plants again

were considerable wider, just like those of the tetraploid plant (Figs 19—20). That spontaneous, somatic polyploidization had happened was confirmed by the fact that the spores which developed on these frond segments (otherwise absolutely abortive on the 2x level) regained their fertility. By sowing these spores, we arrived back to a tetraploid completely corresponding to the original 4x plant. This somatic chromosome doubling appeared in all kinds of transition from whole pinnae to a single sporangium with a rather high frequency on

almost every fronds. It is possible that this somatic polyploidization is attributable to the unbalanced state or interaction of the inhomologous genomes of the diploid hybrid, which may have happened in the same way at the origin of the allotetraploid *C. fragilis*. Spontaneous somatic polyploidization of sterile interspecific fern hybrids is in general very rare (cf. BUTTERS and TRYON 1948). It is more frequent that some unreduced, and therefore already fertile spores appear among the bad spores (LOVIS 1968b, LOVIS and REICHSTEIN 1968, LOVIS 1970).

Summary

The genome analysis of the tetraploid taxa of the *Cystopteris fragilis* complex, x = 42 (incl. *C. dickieana*, *C. diaphana*, *C. regia*, *C. protrusa*) is presented. In the meiosis of the hybrid of the tetraploid and hexaploid *C. fragilis* s. str., c. 2x pairs and x univalents develop, indicating that the tetraploid is part parental to the hexaploid. The 4x *C. fragilis* has become built in — by at least one genome — also in the 6x *C. regia*, since the number of bivalents in their hybrids is between 50 and 70. By preventing the fertilization on the gametophyte, we produced from the 4x *C. fragilis* a sporophyte with reduced chromosome number 2n = 84, the meiosis of which makes the alloploid origin of the 4x *C. fragilis* likely. None of the genomes of the 4x *C. fragilis* is identical with the North American diploid *C. protrusa*, since in the synthetic hybrid only few bivalents are formed. Similar pairing has been observed in the triploid hybrid of the *C. dickieana* x *protrusa*. The synthetic sterile hybrid of the two tetraploid taxa (*C. fragilis* x *dickieana*) suggests that they have only one common genome. As to their origin, three unknown diploid species should be assumed, and with the genome analysis of the 6x taxa, additional hypothetical diploids have to be considered. In the 2x *C. fragilis* produced by apogamy, spontaneous polyploid segments occur with considerable frequency, which may demonstrate also the way of origin of 4x *C. fragilis*.

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PRODUCTIVITY OF VEGETATION IN THE IBP EXPERIMENTAL AREA AT ÚJSZENTMARGITA

By

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The study sums up the findings of investigations into the primary production of the "Tilos erdő" (Tilos forest) lying in the NW margin of the Hortobágy. The region was and still is of a forest steppe character, with a mosaic vegetation. The plant communities studied were the foliage production of *Galatello-Quercetum roboris* and of the undergrowth (above-ground and underground plant parts) in the *Polygonatum* and *Poa* facies; *Peucedano-Galatelletum punctati; Artemisio-Festucetum pseudovinae, Achilleo-Festucetum pseudovinae* (grazed and ungrazed stands), and of cultivated fields. The production of supra- and subterranean plant parts of natural communities was examined. The general productivity, efficiency, turnover time and production rate are discussed. An explanation of the forest boundaries experienced in the area is also submitted.

The research team of the Botanical Research Institute of the HAS began its productivity examinations, within the framework of IBP, in the nature conservation area of the "Tilos erdő" near Újszentmargita on the NW edge of the Hortobágy, in the spring of 1966.

The selection of the sample area was decisively influenced by the following considerations:

1. The area is a characteristic part of the greater environs of the Central Tisza region, thus the results obtained may be generalized for a large area.

2. A considerable part of the sample area (about 60 ha) is a nature conservation area since 1948. Its state of conservation affords undisturbed sampling and experimenting. Researches of archives revealed the history of the forest since the end of the Middle Ages. The area was a forest for hunting.

3. Prior to productivity investigations we had already explored the composition of the vegetation by floristical (Máthé 1933, Soó and Máthé 1938), and geobotanical researches (Máthé and Tallós 1967, Máthé, Tallós and Zólyomi 1967, Tallós and Tóth 1968, Zólyomi 1967, Zólyomi and Simon 1969, Zólyomi and Tallós 1967). In the conservation area and its environs all characteristic vegetation types can be found from the trans-Tisza sodifying forest-steppe to the alkaline plain and through the semi-cultivated derivates to arable fields.

4. The detailed vegetation map of the conservation area (Tallós—Tóth 1968) drawn previously by the research workers of the Scientific Institute for Forestry (ERTI), was completed on the basis of aerial photograph (Fig. 1).

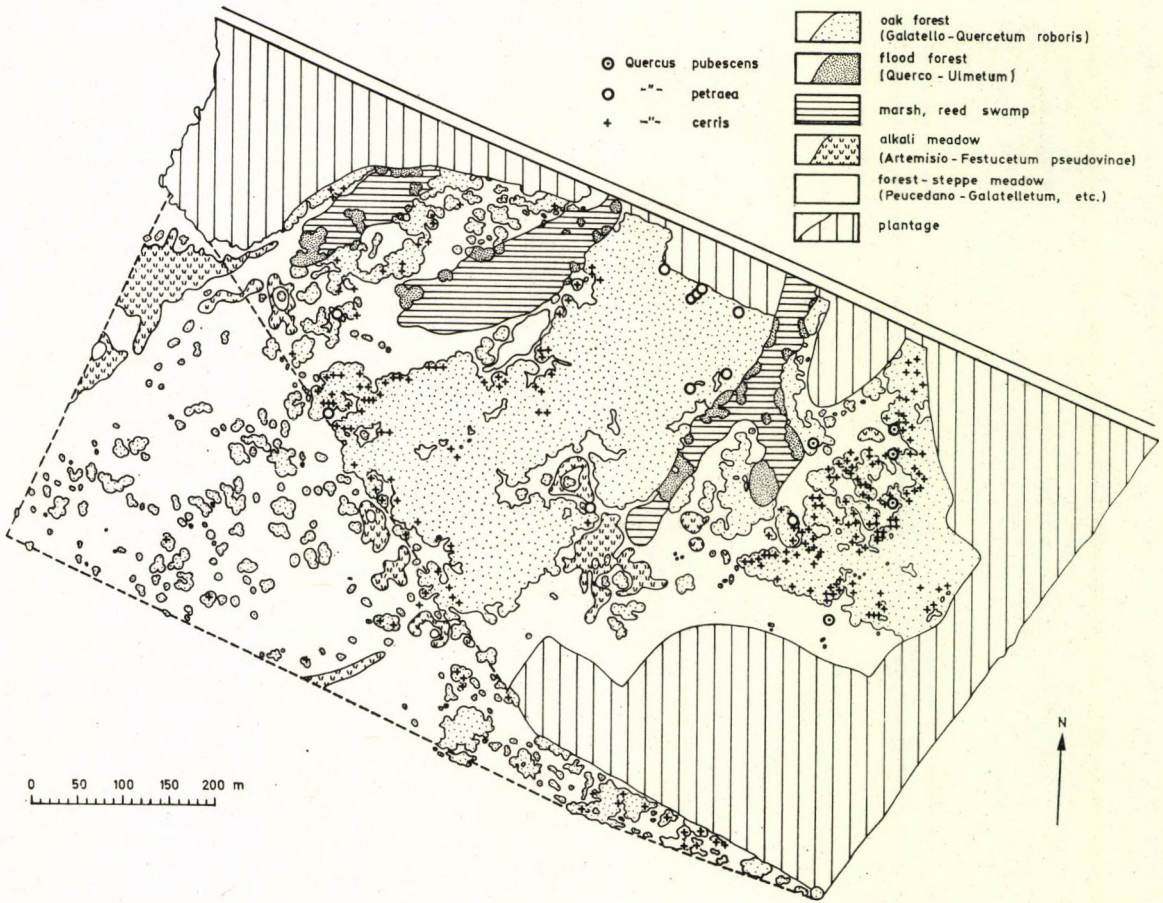


Fig. 1. Vegetation map of the "Tilos erdő" at Újszentmargita (ZÓLYOMI 1966)

5. The results of basic research in the National Park "Hortobágy puszta" are available.

The task of the team was the assessment of the quantity of the terrestrial primary production and the investigation of its laws. Summarizing reports on the partial results have already been published previously (MÁTHÉ 1968b, c, d; 1971a, b).

Our Institute created an interdisciplinary co-operation with the Meteorological Institute of the L. KOSSUTH University, Debrecen conducting bioclimatological examinations in the sample area (BERÉNYI—NAGY 1968, NAGY 1970) — and with the Zoosystematical Institute and Soil Zoological research team of the L. EÖTVÖS University, Budapest (secondary production examinations). Certain soil ecological examinations were made by the research workers of our Institute up to 1971 (MÁTHÉ, ZÓLYOMI, PRÉCSÉNYI and KOVÁCS 1967) when those of the Research Institute of Pedology and Agrochemistry of the HAS joined in the research work.

Material and method

The plant communities studied were as follows (in brackets the abbreviated forms of their names used in the text): *Galatello-Quercetum roboris* ("*Quercetum*"), *Peucedano-Galatelletum punctati* ("*Peucedanetum*"), *Artemisio-Festucetum pseudovinae* ("*Artemisietum*"), *Achilleo-Festucetum pseudovinae* ("*Achilleetum*", pasture and part of the pasture ungrazed since 1968), and various cultivated fields.

In 1966 piloting and methodological examinations were made (MÁTHÉ, PRÉCSÉNYI, ZÓLYOMI 1967; PRÉCSÉNYI, MÁTHÉ 1969), and beginning with 1967 systematic investigations have been conducted. Three times a year, in April, June and September, samples were taken from the natural stands, while from the semi-cultivated and cultivated stands monthly sampling was performed in the vegetation period the number of samples and plot size varied according to stands. Phenological observations were made monthly (MÁTHÉ 1967, 1968a).

Meteorological observations took place in the forest, in the *Peucedanetum*, and in the ungrazed part of the *Achilleetum*. In the forest the instruments for measuring above the canopy were placed on a pyramid of 16 m height. The recording parts of the instruments were given place in a house for experiments.

Results

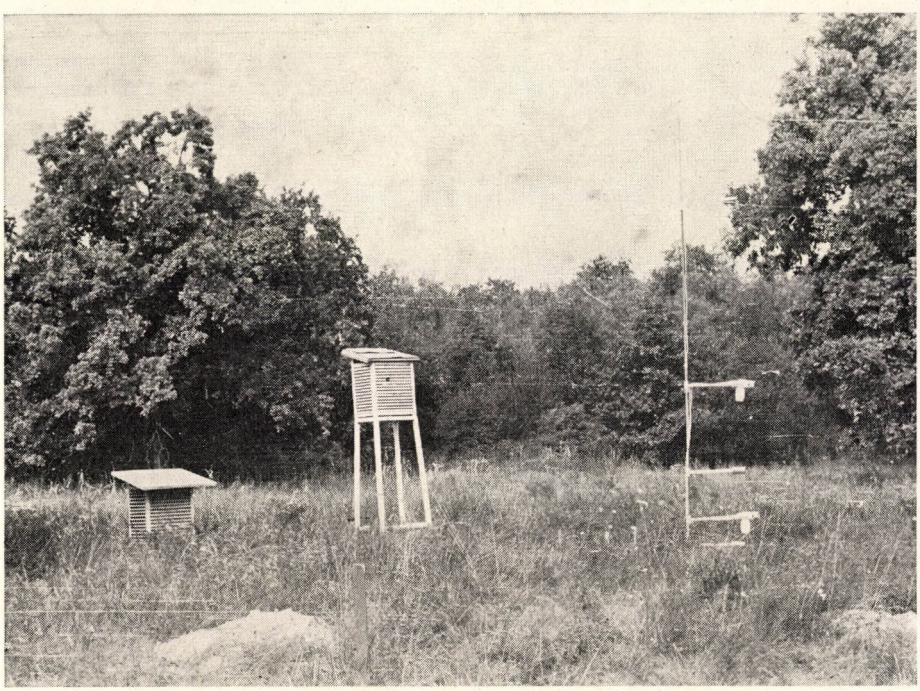
The forest ("Quercetum")

Foliage productivity

The foliage productivity above 1 m level of shrubs and trees are measured since 1970 (SZŐCS 1972). The estimation of mass production of wood representing a considerable part of production in the forest, was performed in 1963 by the forestry engineer, head of the Experimental Station for the Afforestation of Alkaline Soils, ERTI, Püspökladány.

On the basis of our two-years data, the foliage productivity of the forest can be put to 4.6 g/m²/day, from April till September. About 72% of this is foliage leaf, while the remaining 28% breaks down to twigs (smaller than 1 cm in diameter), inflorescences, fruits, etc.

Photograph 1. Characteristic part of the forest with litter trap, the characteristical growth of the *Acer tataricum* trees, constituting the second foliage level, are conspicuous



Photograph 2. Meteorological station in one of the forest clearings

In 1970, a considerable part of the oak trees was infected by powdery mildew. Hence the weight of leaves fallen while green was twice and a half (60 g/m^2/year), while the ratio of production related to that of the whole year (7.5%) was almost the double, of the values measured in 1971 [24 g/m^2/year and 3.9%, respectively]. The weight ratio of green and dry leaves was 1 : 8.4 in 1970, and 1 : 17.0 in 1971. The infection by powdery mildew, although it significantly increased the falling of green leaves had in effect still increased foliage production by inducing the trees to compensate for the lost assimilating surface. The distribution of the total production mentioned above (72% leaves and 28% other parts) did not change even by the effect of infection by powdery mildew. Assumably, the increment of woody mass had at the same time diminished.

The average caloric content of the dry leaves fallen in the autumn was 4.6 Kcal/g [without ash 4.9 Kcal/g].

Productivity of the undergrowth

In the more closed parts of the forest, a subassociation characterizable by *Polygonatum latifolium* developed. Two facies can be distinguished here: that of *Polygonatum latifolium* and of *Poa nemoralis* (Zólyomi—Tallós 1967, Tallós – Tóth 1968). The productivity of the two facies are studied since 1967 (Zólyomi—Précsényi 1970).

Polygonatum facies

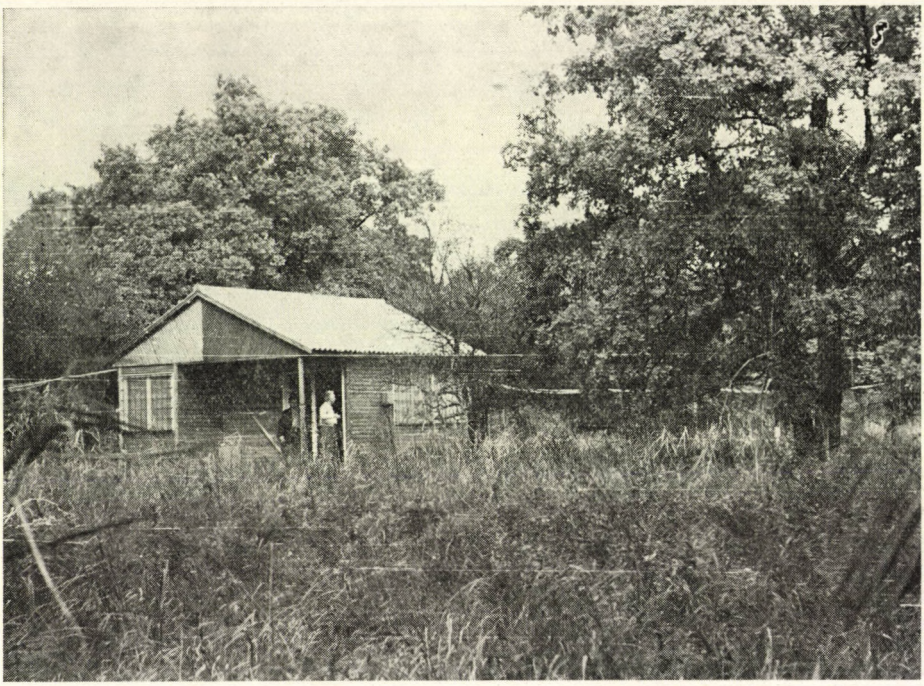
The productivity of the above-ground parts, counted for the vegetation period, can be estimated as 0.14 g/m^3/day, while that of the underground parts as 0.02 g/4 dm^3/day.

The turnover time of the above-ground parts is short (1.4 year), while that of the underground parts is long (4—5 years). This result corresponds well with the life span of the rhizome in *Polygonatum*.

The above-ground parts are produced rapidly: 25—65% of the annual production can be measured in April and 65—90% in June. The production rate of the underground parts is slower (25—36% in April and 55—72% in June).

Poa facies

The productivity of the above-ground parts in this facies is 0.18 g/m^2/day counted for the vegetation period. The productivity of the undeground parts can be estimated as 0.02 g/4 dm^3/day. The turnover time of the above-ground parts is more rapid also in this facies (1.3—2.4 years) than that of the underground parts (3—4 years).



Photograph 3. Research house for self-recording meteorological instruments

Photograph 4. Artemisio-Festucetum pseudovinae with *Galatella punctata* blossoming in masses; in the background a group of *Quercus* trees surrounded by *Peucedano-Galatelletum punctati*

The rate of production in the above-ground parts is slower here than in the *Polygonatum* facies (*Poa* facies 15—40% in April, and 45—75% in June). The production rate of the underground parts is almost identical with that of the *Polygonatum* facies.

Transect examinations

On the basis of data obtained with geobotanical methods it was assumable that in the sodifying forest-steppe forest mosaic the boundary between forest and steppe is determined by soil conditions.

In regard of this question a debate evolved, with Professor H. ELLENBERG at Újszentmargita. He queried the natural state of the forest border and contended its artificiality owing to grazing. However, the forest was used for hunting since the Middle Ages, and no grazing has ever been allowed in it.

In three transects, — beginning with the *Quercetum*, through the *Peucedanetum*, and extending into the *Artemisietum* — the per cent cover of the plant species was estimated in m^2 plots. A soil sample from the upper 20 cm layer was taken in every m^2 plot. The analysis of the soil samples was performed for about 20 characteristics.

The samples were grouped by factor analysis (Fig. 2). Five factors were drawn out of the initial 130×50 matrix. In the interpretation of the data, the first three factors were used. Assumably, factor axis I can be related to the humus percentage and the nitrate content of the soil. We have not succeeded in finding the explanation for factor axis II so far. Factor axis III may be correlated with the thickness of the surface soil and changes in Na ion concentration. Accordingly, our explanation of the development of the forest border by soil characteristics appears to be justified.

Steppe meadows

(*"Peucedanetum" and "Artemisietum"*)

Of the two steppe meadow associations the "*Artemisietum*" was studied in detail (MÁTHÉ, PRÉCSÉNYI 1972; PRÉCSÉNYI 1967; 1968a, b; 1969a, b; 1970; 1971a, b; PRÉCSÉNYI, MÁTHÉ 1969). This association ranges extensively on IIIrd class alkaline soils. Since it is not utilized (grazed) in the nature conservation area, it may serve as control in comparison with grazed stands.

"*Peucedanetum*"

The productivity of the above-ground parts of the *Peucedanetum* can be estimated at 2 g/m^2/day in the vegetation period. The productivity of the underground parts varied between 0.04 and 0.17 g/4 dm^3/day.

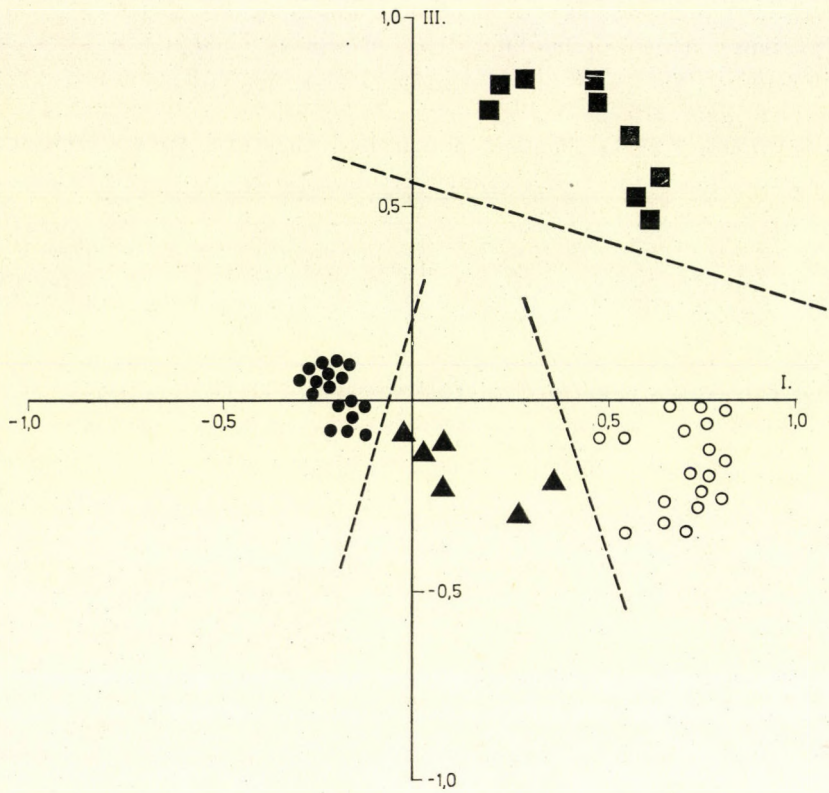


Fig. 2. Position of the phytocoenological surveys in the factor field determined by Factors I and III ○ = *Quercetum;* ● = *Peucedanetum;* ■ = *Artemisietum;* ▲ = transitional surveys

Efficiency varied between 0.08 and 0.66%.

The turnover time of the above-ground living parts is rapid, an average of 1.2 years; that of the underground parts is longer (about 4 years).

During spring sampling (April) merely 4—7 (—20)% of the annual above-ground production was measured. Between April and June, the association produces rapidly, in June 40—65% of the total annual quantity was measured. The production of the underground parts is slower between April and June from (25—35% to 59—64%) than between June and September (from 59—64% to 100%).

"*Artemisietum*"

The productivity of above-ground living parts is 1.41 g/m/day^2 (average of five years). In the underground parts, a loss of 0.01—0.05 g/4 dm^3/day was found for vegetation period.

Efficiency varied between 0.14 and 0.42% in the course of years. In the two steppe associations a minimum efficiency occurred in 1968, and a maximum in 1970.

The turnover time of the above-ground living parts is 1.6 years, that of the underground parts 5.2 years. The turnover time of the underground parts is slower also in this association than that of the above-ground parts.

15—20% of the total annual above-ground production can be measured already when sampling in April, then its 40—65% in June. This indicates that the production of the *Artemisietum* is slower between April and June that of the *Peucedanetum*. The situation is reversed in the underground parts. Production between April and June is more rapid in the *Artemisietum* (from 25—35% to 68—72%) than in the *Peucedanetum*.

The pasture

The *Achilleetum* lying outside the nature conservation area is grazed. Part of it has been excluded from grazing since 1968 (MÁTHÉ—PRÉCSÉNYI 1970). The dominant species of the pasture is *Festuca pseudovina*, responsible to even 80% of the production. During the spring also moss species provide a considerable amount of weight in the grazed area.

A comparison of the above-ground productions of the grazed and ungrazed stands it was found that 50—80% of the vegetation is consumed (grazed) by animals.

Productivity can be put to 0.5 g/m²/day in the grazed areas, and only to 0.8 g/m²/day in the ungrazed parts.

The yearly fluctuation of efficiency is great, presumably depending on the quantity of precipitation.

The turnover time of the above-ground parts is shorter in the grazed stand (1.8 years) than in the ungrazed stand (2.4 years).

Arable fields

Besides investigating natural and semi-cultivated plant associations the examination of agricultural plant cultures is considered also important (MÁTHÉ, PRÉCSÉNYI 1968, 1971).

The sequence of cultures in the fields were as follows: barley in 1966; wheat (Besostaya 1) in 1967—68; maize (Szegedi 71) in 1969; a mixture of barley and red clover (Mk 42 and Fertődi M) in 1970; red clover (Fertődi M) in 1971.

The productivity of maize was the greatest [19.5 g/m²/day]. In farming utilization — owing to mowing four times a year — red clover presumably has a productivity even greater than that of maize.

Beetwen July and September, the efficiency of maize approached 4%. In wheat, the efficiency was 1.5%. In certain periods, the efficiency of the barley-red clover mixture and of the red clover stand was near that of wheat, despite mowings.

Turnover time in wheat and maize was calculated at 1.02 and 1.01 years, respectively.

In 1968 and 1970—1971, the number of weed seeds, down to a depth of 10 cm in the arable fields was also estimated. In spring and autumn they were about identical in number [338—348 seeds/0.1 dm^3], while in summer the number of seeds was fewer (285 seeds per 0.1 dm^3). Differences were found also in the yearly averages.

*

The authors express their gratitude of the help rendered by the assistent workers participating in the investigations.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 20 (1—2), pp. 205—214 (1974)

RECENSIONES

Vegetationsmonographien der einzelnen Grossräume. (Editor H. WALTER). I. R. KNAPP: Die Vegetation von Nord- und Mittelamerika und der Hawaii-Inseln, 1965, 373 pp., 170 maps, 335 plates, 64 DM. — II. K. HUECK: Die Wälder Südamerikas. 1966, 422 pp., 253 figures, 80 DM. — II. a. K. HUECK und P. SEIBERT: Vegetationskarte von Südamerika. 1972, 71 pages, 1 coloured map, 28 DM. G. FISCHER Verlag, Stuttgart.

The renown publisher, G. FISCHER launched a new series of plant-geography of wide scope, proposed to be a complementary volume to Vegetation der Erde in öko-physiologischer Betrachtung (ed. H. WALTER), in two volumes (1964—1968, reviewed in Acta Bot. Hung. **15**, 204—205, 1969). The causal treatment of vegetation is in the forefront also here; the main classification of vegetation is based on climatic zones. Floristical differences are pushed into the background, but a short characterization of the prevailing vegetation types in the meaning of formations or alliances, with an enumeration of the dominant and characteristic species, also appears. Macroclimatic conditions, considerations of vegetation history, and the effect of culture are emphasized everywhere, and often forestry and agricultural implications as well.

Professor KNAPP, Giessen, the well-known researcher also of the vegetation of Central Europe, the author of several hand-books,* describes the vegetation of North- and Central Amerika on the basis of his journeys — lasting for nearly 12 years — in North America, and of more than 1200 quoted works. The discussion is divided into 11 large chapters:

Vegetation (V.) of Eastern and South-eastern North America (hereinafter N. A.); V. of the zones with Boreal Coniferous Forests in N. A., Arctic and Alpine V. beyond the Timberlines (Arctic V. and Alpine V. above Timberline in Western and South-western N. A.); V. of the zones with Coniferous Forests in Western N. A.; V. of the zones with Evergreen Sclerophyllous woodlands and Scrubs in South-western N. A.; V. of the Prairie Areas in Central N. A.; V. of Northern Deserts and Semi-Deserts in N. A.; V. of the area with Predominantly Neotropical Flora in Central A. and Southern N. A. (a. V. of the Deserts and Semideserts, b. Neotropical V. of the Lowlands, c. Mountain V.), V. of the Hawaiian Islands.

Emer. Prof. HUECK, Munich, did not live to see the publication of his work. He spent ten years in the forests of South America, then, during his further journeys, also studied the areas important from the point of view of forest plant geography and forest cultivation, the synecology and composition of forests, as well as their economic importance. The book deals with natural and artificial renovation, competition between the various species, formation of secondary forests, harmful effects of forest destruction economically important wood

* Einführung in die Pflanzensoziologie, ed. 3. Stuttgart, 1971; Experimentelle Soziologie u. gegenseitige Beeinflussung der Pflanzen, ed. 2., Stuttgart, 1967.

species, etc. South America is divided into 40 forest regions; the vegetation types of these are characterized thoroughly. Individual forest associations or types are in general omitted, and only a few pages are given to a summary on areas without, or poor in, forests.

On the basis of a 1 : 8 000 000 map left by HUECK, (and by completing it), SEIBERT constructed the vegetation map of South America. It shows 88 vegetation regions, relegable to the following main groups: Tropical and subtropical rain forests: Deciduous and mesophilous tropical and subtropical forests: Xerophilous forests: Savannas, palm-savannas and palm-forests; Shrub- and grass steppes, semi-deserts and deserts; Southern forests; Subantarctic and Andine high-montane vegetations, Hygrophilous forests (gallery forests, mangrove). — Notes in German and Spanish to all regions and vegetations furnish data on the horizontal and vertical distribution, characteristic macroclimate, main types of vegetation (as formations), their characteristic species, economically important trees, culture plants, and the prevailing forms of economy, and also referring to the corresponding parts in HUECK's book.

The layout of all three works is perfect (as generally are the publications by FISCHER Verlag), the figures and photographs are excellent, their price (in the German book-market) about moderate. The next volume of the series to be published — still in 1973 — will be the Vegetation von Afrika.

R. S.

I. HORVAT (†), V. GLAVAČ, H. ELLENBERG: Vegetationskarte von Südosteuropa. 1972, 20 pages 1 coloured map, 28 DM. — G. FISCHER Verlag, Stuttgart

On the basis of the legacy of the late Professor IVO HORVAT, Zagreb, the three authors compiled the work entitled Vegetation Südosteuropas (some 1000 pages), forthcoming in 1973. Its map, scaled 1 : 2 000 000, has been published also separately in advance. This shows the potential natural vegetation (as is recently a custom), that is, it is a climate-zonal vegetation map, displaying the natural zones of the various alliances, and sometimes of the suballiances or associations subzones. It is welcome point that the southern part of the Hungarian Plain is no more considered a natural steppe habitat (as did earlier HORVAT), but a steppe woodland, however, the text says "nach unseren Untersuchungen", whereas Hungarian geobotany (since Soó 1926—29, cf. Soó, Journ. of Ecol. **17**, 1929, 329 ff , Nova Acta Leopold, N. F. **56**, 1940 Karte, Phyton **8**, 1959, 114 ff.) has advocated this since nearly 50 years. Unfortunattely, the Yugoslavian authors rather neglect studies by Hungarian botanists on the vegetation of the Balkan (BORHIDI: *Fagion illyricum*, 1963—66; JAKUCS: Flaumeichenbuschwälder 1961, Waldsäume 1972, Soó: Fagion Verbände Südosteuropas 1964), although *Fagion dacicum*, established by the present reviewer, is duly acknowledged.

The zones of the map are as follows:

1. Mediterranean evergreen sclerophyll forest zones (*Oleo-Cerationion* and *Quercion ilicis* zones), 2. Submediterranean winter decidous forest zones (*Ostryo-Carpinion orientalis*), 3. Continental winter decidous forest (*Quercion "frainetto"* recte *farnetto*) and steppe-woodland (*Aceri-Quercion*) zones, 4. Central European winter decidous forest zone (*Carpinion betuli illyricum*), 5. Central European montane beech and fir forest zones (*Fagion illyricum*, *F. moesiacum*, *Rhododendro pontici-Fagion orientalis*, *F. dacicum*), 6. Montane and subalpine coniferous forest zones (*Abietion cephalonicae*, *Pinion peucis*, *Vaccinio-Piceion*), 7. High mountain vegetation zones (*Seslerietalia* and *Daphno-Festucetalia*). The map drawn by GLAVAČ is rough-and-ready locally nor are its colours always satisfactory. The most reliable is the part concerned with Yugoslavia. In comparison with the other publications by FISCHER, the price is rather high.

R. S.

GÉCZY, B.: Palaeobotany, 1972, 356 pp., 18 tables. Tankönyvkiadó, Budapest, 55 Forints (in Hungarian).

The work is not the first Hungarian palaeobotany; that was written by G. ANDREÁNSZKY (1954) — in his time on an up-to-date level, and partly more detailed — but it is the first university textbook as such. The former was written by a botanist, the latter by a palaeontologist. This has an influence upon the work. The best are the introductory chapters on methods, and the geological parts (fossil plants as rock-forming plants, their role as indicators of environment; unfortunately, the valuable, partly home results of palaeocoenology as period indicators — cf. ANDREÁNSZKY and others are not mentioned here), further, age division on a palaeobotanical basis, as well as the description of the flora and (partly) the vegetation of the various periods. A contradiction occurs in taxonomical division between the survey on p. 44 and the discussion, incorrectly treating "*Chlamydospermophyta*" as a separate phylum. *Chlamydospermophyta* are heterogeneous, and they appear in all recent plant systems (Soviet: TAKHTAJAN Hungarian is written as TAKHTADZSJAN, American: CRONQUIST, German: EHRENDORFER, or Hungarian: Soó) as a class at the most. Moreover, the division of *Gymnospermae* has also become outdated (cf. the systems mentioned above); when raising a group the phylum level (*Thallophyta* and *Cormophyta* in GÉCZY), the suffix- *bionta* should be used. In the same way, when algae are summarized under the name *Phycophyta*, the phyla appearing under them cannot bear the suffix *-phyta*, but the suffix *-phytina* (if considered as subphyla), or the suffix *-phyceae* (if considered as class, as in the recent edition of the Bonn textbook by MÄGDEFRAU). It is unfortunate that the author is not fully versed in the rules of nomenclature, not it seems, the botanist reviser.

In the phylogenesis of plants, reductive development, namely simplification, cannot be left out of consideration. This may mean the peak of development — cf. orchids in monocotyledons — just as well as the acmes of the differentiating, progressive, and reductive (*Gramineae*) cf. grasses trends. The author also mentions the good example of the reductive development which has led from the *Sigillariae* of tree stature (Devonian — Carboniferous), through *Pleuromeia* (Triassic) and *Nathorstiana* (Jurassic), to the small-statured recent *Stylites*, and *Isoëtes* (p. 103). Unfortunately, he does not refer to the summarizations of the present rewiever published also in Hungarian, cf. Textbook for the Teachers' Training College, 1963, pp. 786—808; Természettudományi Közlöny, 1966, pp. 481—484, 538—541; Hauptzüge der Evolution der Embryophyten; Feddes Repert. **76**, pp. 63—81 (1967); and in Russian in the Botan. Journ. **53**, pp. 289—300 (1968) — I agree with the author that he omits the various recent theories of phylogenetical evolution, especially those of the sometimes fantastic di- and phylogenetics. One of the authors traced back the primordial *Angiospermes* (*Magnolia* × : 19) the hybridization of *Gnetum* (× : 7) and *Gingko* (× : 12). — However, the fossil mosses, mentioned in two places by the author, are of the same value (although he himself also considers it possible) — a view generally accepted today — that these fossil mosses are merely disfigured root remains. On p. 226 the spelling "Hepaticaefiton" is incorrect. I do not wish to go into further details, except that I am incorrectly mentioned (p. 11) among spore and pollen investigators. On the other hand, the pollen types were laudably included (p. 314). To sum up: the book is a modern, thorough valuable work, and it fulfils its purpose in meeting the requirements of a really good textbook. R. S.

TÜXEN, R.et collab. Bibliographia Phytosociologica Syntaxonomica. Lief. 1.—18. Verlag J. CRAMER, Lehre (BRD), 1971—1973.

I already reviewed briefly (Acta Bot. Acad. Sc. Hung. **17**: 464) this new project by (R. TÜXEN), the leading syntaxonomist of the western world; it contains, under the above title, the literature references of all sociological units (from classes to associations). The author

collected his material over 40 years, and the last fascicles carry also the latest literature. Naturally, no complete bibliography exists — while the author cites Western literature almost in full he cites from East European literature rather that based on the Zurich-Montpellier School, thus especially the Czechoslovakien, Yugoslavian, Polish, Hungarian and Rumanian authors. As against this, literature of Soviet origin is found only exceptionally, even the great summarizing work by B. A. BIKOV is missing (Dominanti rastitelnogo pokrowa sowjetskogo sojuza I—III. Alma-Ata 1960—1965), through it contains the names of several thousands of "associations" and of other authors and works, (above 600 cited in it), as well as the recent Soviet literature. Naturally, the "associations" of most of the Soviet authors are not equivalent with those of the Central European School, but those of the contemporary GROSSHEIM School as well as those by several, mainly Ukranian, authors are (for example, BILYK and others). The Fenno-Skandinavian papers, at least partly, are probably missing for the same reason, although they are concerned rather with the classes not yet dealt with. I do not consider it wholly fortunate that the same association is cited in separate groups (according to whether the original citation appeared withouth the author's name, or with different names; with the year of publication given or without it; or coupled with a different specific name). [I mentioned an example already in the first review; to wit: *Bolboschoenus maritimus* Ass. Rapaics. 1927 (prov.), *Bolboschoenetrum maritimi*, *B. m.* Soó, *B.m.* Soó 1927, *B.m.*Soó 1927 et Tx. 1937, *B.m.* Tx. 1937, *B.m.* Soó 1940, *B.m.* Eggler 1933, *B.m. continentale* Soó (1927)1957 — this is the correct denomination —, furthermore, some more than 20 various *Scirpetum maritimi*, which at least partly belong to the former association]. It also occurs several times that the same literature citation occurs at several places, under identical or different names. Incidentally, the critical arrangement is planned for the future "Prodromus der europäischen Pflanzengesellschaften". This, however, will hardly be satisfactory if the authors omit a large part of Eastern Europe.

It sometimes occurs that the original paper of an author, whose name is given after the association name (often with the year), is not cited. For example, in the fascicle on *Bidentetea* FELFÖLDY's studies on weeds, although the author cited them on earlier occasions, for example in 1950. It is also confusing that several associations, not indigenous to the country mentioned are cited for example alpine associations from Hungary the reports obviously refer to an earlier territory of the country, prior to 1918, e.g. *Arabidetum coeruleae* (L. 7 : 16) *Cardamine amara* ssp. *opizii-Cratoneurum decipiens* Ass. (L. **13**: 26 under two names), *Saxifrago-Cratoneuretum* (L. **13**: 44), *Avenastretum "decori"* (l. **18**: 24), *Dryadetum* (L. **17**: 39), *Elynetum* (L. **17**: 45), *Festucetum carpaticae*, *F. pumilae* (L. **17**: 48, 49), *F. saxatilis*, *F.s. subalpinum* (L. **17**: 50), *F. versicoloris* (L. **17**: 52), *Semperviretum* (L. **17**: 64), *Szeslerietum bielzii* (L. **17**: 65), *S. rigidae* (L. **17**: 70 under three names), etc.

Even more unfortunate is the mistake of relegating the *Szesleria* swards of the Hungarian Central Range to the alpine *Elyno-Szeslerietea*, because these belong in the order *Festucetalia valesiacae* of the class *Festuco-Brometea* in the alliance *Szeslerio-Festucion pallentis* Klika, that is, in its *Diantho-Szeslerion* Soó 1968 suballiance. Cf. Soó Syn. III. F. 23, V. 571, Soó, Acta Bot. Hung. **17**: 145; such, not cited by the author, are *Asplenio rutae-murariae-Melicetum ciliatae* Soó 40 (nom. n.), Syn. V. 571 (list = L) — which is probably included in *Asplenietea* —; *Szeslerio-Festucetum pallentis* (Dostál 1933 "*Szeslerieto-F.duriusculae*") emend. Soó 45, as *Sz.-F.p. subcarpaticum* and *tornense* (*Campanulo divergentiformis-F.p.* Zólyomi 1966) — cf. ZÓLYOMI, Bot. Közl. **53.** 1966: 51—53, which is not included either —; the entire synonymy given in Soó Syn I. 198, the association names beginning with *Festuca* will probably appear in the fascicle treating *Festuca-Brometea*; finally, *Diantho-Szeslerietum heuflerianae-hungaricae* Soó (1959) 1962 (this has also been omitted; it is only cited after 1971), the names assignable to this are *Szeslerietum heuflerianae* Soó nom. n. 1933, 1960, 1961, Jakucs 1952, 1954, 1955, *Sz. heufl. bükkense* Zólyomi 1933, 1936 Liste, *Sz. hungaricae* Jakucs 1961 etc. but neither the names nor

the papers are cited. (Entire synonymy in Soó Syn. I. 199, V. 571). Still less can *Seslerietum sadlerianae* [(Soó 33 as *S. budensis* nom. n.) Zólyomi 1936 L. of *S. budensis*, 1950 legitimate name cf. Soó Syn. I. 199, V. 570], relegable to the alliance *Bromo-Festucion pallentis* Zólyomi 1966. l.c. of the class *Festuco-Brometea* class, be assigned to the *Elyno-Seslerietea*. Presumably the filing of the cards to diverse places was the cause of having the names of the same associations appearing in different classes and fascicles.

Some other striking mistakes should also be pointed out. Lief. 5. *Ruppietea*. In my opinion, the halophilous *Parvopotamogetono-Zannichellietum pedicellatae* belongs here (Soó 1934, Magy. Biol. I. M. **7**: 137 pp.), Soó 1947 a L. (also Soó Bot. Közl. **35**: 250 as *Parvop.-Zann.*), not identical, not even related to, *Parvop.-Zann.* (Baumann 1921) Koch 1926. (L. **14**: 64—66). I whould assign rather here also the association *Ranunculetum aquatilis-polyphylli* (*Batrachio aquat.—Ran. polyph.* Soó 1961—62—64—71; this name is also missing) several aquatic *Ranunculus* species, and *Zannichellia pedicellata* are *Ruppietea* as well as *Ruppion* species (cf. Soó Syn. III. F. 13)

Lief. 14. *Potamogetonetea*. *Hydrocharitetalia* v. *Hydrocharition* fits here with difficulty; OBERDORFER's conception is more correct (1967, 1970), by drawing it into the class *Lemnetea* and gives the prov. name *Hydrocharito-Lemnetea* to it; I also follow this; (1971, Syn. V. 534); indeed, I enumerate here even the *Ceratophyllum* associations standing between *Lemnion* and *Hydrocharition* (*Ceratophyllion* Den Hartog et Segal). At least the associations of the floating waterplants belong to one class.

Lief. 10 *Thero-Salicornietea*: 13. *Bassietum sedoidis* (not *sedoides!*) is the same association (in. Lief. **16**: 67) as *Echinopsiletum sedoidis* with the *Astereatea tripolium.**

On the other hand, wide spread associations, missing in both fascicles are as follows: *Hordeetum hystricis* (Soó 1933 as facies) Wendelbg. 1943, 1950 Table. Soó 1947: 23 T and *Camphorosmetum annuae* (Rapaics 1916 nom. nud.) Soó 1933a T., 1938 as *C. annuae*. Both should belong in the group *Puccinellion limosae* (cf. Soó 1947: 23, 26, 1957: 363—64, Syn. I. 179—180, 1971: 142, Syn. V. 561; WENDELBERGER 1950: 83), and thus in the author's class *Asteretea tripolii*. However, WESTHOFF's class contains exclusively Western halophilous associations, and thus coincides with *Juncetea maritimi* Br.-Bl. (cf. Soó 1971: 132); TÜXEN himself cannot separate them, and therefore (unusually) he treats the units belonging to two classes together. If the oldest name, *Puccinellio-Salicornietea* Ţopa 1939, cannot be applied, since it also contains the *Thero-Salicornetea*, then the Central to Eastern European associations, and those of the alliance *Puccinellietalia* and *Artemisio-Festucetalia pseudovinae* (cf. Soó Syn. I. 176—188, V. 560—564, Soó 1957: 360—373, 1971: 141—143) belong in a class with another name. I suggested the name *Festuco-Puccinellietea* (Syn. III. F. 6. 1968). The name *Halostachyetalia* Grossheim 1929 (in Ţopa 1939) cannot be used either — as a Soviet author he is not contained in Tx. — since Ponto-Central-Asian associations belong there, extending to Romania in the western direction (cf. Soó 1937: 373).

Lief. 16. *Asteretea* etc. *Beckmannion erucaeformis*, correctly *eruciformis*. The author does not know RAPAICS's papers (Gazdasági Lapok, 1916; and Debreceni Szemle 1927; cf. Excerpta Bot. B. **2**: 113), where many names (nom. nud. or list fragm.) appear. Nor are the following ones included: *Agrostis alba-Alopecurus geniculatus* Ass. Magyar 1928: 52, *Agr. alba-Atriplex hastata* ass. Soó 1930: 33, T; *Agr. alba-Carex distans-Eleocharis palustris* Ass. Soó 1938c: 105, T (= *Agrostio-Caricetum distantis nyirségense* p. 41; *samicum* Soó 1947b: 37 is also missing); at *Agrostio-Alopecuretum prat.* (Soó 1947b; 37 T 1971: 142, as well as; at *Agrostio-Beckmannietum* Soó 1933: 12, 1947b: 40 T, etc. *Agrostio-Eleochari-Alopecuretum geniculati*

* The original *Asteretum tripolii* (*Tripolium* nom. sing., gen.: *tripolii* is correct agains Tx. earlier *Convolvulion sepii* (*saepes* nom. plur., gen. *saepium*), which is still cited in this way by certain authors.

Soó (1939), 1947b: 38 T, *Agrostio-Glyerietum poiformis* (printing error: *proiformis*), Soó (1933 nom. n.) 1947b: 38 T, *Aster pannonicus-Puccinellia limosa* ass. Rapaics 1927b. *Astero-Triglochinetum* Soó 1947b; 27 T, *Atropis peisonis* Ass. Höfler 1937: 329, ibid. *Atropis-Lepidium crassifolium* ass., — these are so far the missing items under the letter A, while the following ones are examples of the others: *Festuca arundinacea-Carex distans* ass. Rapaics 1927: 10 L, *F. pseudovina-Peucedanum off.* Ass. Rapaics 1927b: 12, *Glyceria poiformis-Alopecurus pratensis* Ass. Magyar 1928: 52, *Camphorosma ovata-Lepidium cartilagineum-Puccinellia limosa* Ass. Rapaics 1927: 16, 17, *Lepidio-Puccinellietum limosae* (Moesz 1940 as Soz.) Soó 1957: 362, *Lepidio-Camphorosmetum annuae* (Rapaics 1927: 16) Soó 1957: 363, *Peucedano-Asteretum punctati* Soó 1947b: 57 (T), *Pholiurus pannonicus* Ass. Rapcs. 1927b: 9 (nom. n.) = *Pholiuro-Plantaginetum tenuiflorae* Wendelbg. 1943, *Plantaginetum cornuti* Soó 1947a: 19, 1947b: 27 T etc.

Lief, 11, *Bidentetea. Alopecuretum aequalis* belongs in *Agropyro-Rumicion crispi*, correctly *Rumici-Alopecuretum geniculati* Tx. (1937) 1950, at *Catabrosetum aquaticae* also Soó 1927. *Bidens tripartitus-Stachys palustris* ass. Felföldy 1943: 65 T, *Chenopodietum rubri* Timár 1948: 78 T = *Dichostylidi-Chenop.* Soó 1971: 152, *Echinochloo-Bidentetum* Soó 1971: 152 (to here belong Timár's *Bidentetum* 1947, 1950, T, Felföldy 1942 T, p. p., Pop 1968, etc.). In my opinion the following items do not belong in *Polygono-Chenopodietalia* but in the group *Chenopodion fluviatile* (cf. Soó 1961, Acta Bot. Hung. 7: 426—450: the author fails to cite this very system of the Hungarian weed associations; further, Syn. II. 216—218, 1971: 152—1953, Syn. V. 586—587): *Echinochloo-Polygonetum lapathifolii* (Ujvárosi 1940: 32 L as *Polygonum lapathif.* as. Soó et Csűrös 1947a: 36 L, 1949: 104 T. The evolutionary forms (subass., facies) and synonyms of this association see in the works by Soó 1961—1973 cited above. Association names missing in Lief. 11, but belonging here, are, among others, as follows: *Polygono-Juncetum* Soó 1927 p.p. (*Junceto-Polygonetum* Soó 1943), *Juncus bufonius-Echinochloa* ass. Felföldy 1942 T (= subass. *juncetosum bufonii*), *Convolvulus-Echinochloa-Polygonum* Komplex Timár 1950b T, *Echinochloo-Chenopodietum* Soó 1940—49, Borza 1959 T (= subass. *chenopodietosum albi*), *Echinochloo-Chenop. polyspermi* Morariu 1943 T (= subass. *chenopodetosum polyspermi*). Some of its subassociations, as *juncetosum bufonii*, *heleochloëtosum alopecuroidis* Timár 1950a T, Pop 1968 T, *cyperetosum fusci-difformis* Soó 1971: 587 (T in Pop 1968), are transitional with the increase of *Nanocyperion* elements into *Cypero-Juncetum* Soó et Csűrös (Soó 1947: 6 L, 1949: 50 T). I also include here *Echinochloo-Setarietum glaucae* Felföldy 1942: 132 T "*Setaria glauca-Echinochloo*-ass.", the subassociation of which is *portulacetosum* (*Panicum c.g.-Portulaca oleracea* Ass. Slavnić 1951 T).

When endeavouring to submit some missing data, or my opinion's of correction, I was complying with the author's wish. One more point: it is probably not worth enumerating all the citations where the association name appears only as a nom. nud. (unless it is a datum to the geographic distribution of the association); but rather the one where its valid description is available (T, or the list enumerating the constant, subconstant, and character species). In the case of pure associations (mainly aquatic ones) I should consider also the simple name as valid. In spite of my critical remarks, I deem the compilation Bibliographia Phytosociologica a huge and very useful work, indispensable for every phytosociologist and coenologist. The publication of further fascicles is eagerly awaited.

Hitherto published are:

1. *Bolboschoenetea maritimi*
2. *Lemnetea*
3. *Spartinetea, Coeno-Spartinetea*
4. *Violetea calaminariae*
5. *Zosteretea marinae, Ruppietea*

6. *Ammophiletea, Honckenyo peploidis-Elymetea arenarii, Agropyretea pungentis*
7. *Salicetea herbaceae*
8. *Epilobietea angustifolii*
9. *Cakiletea maritimae*
10. *Thero-Salicornietea*
11. *Bidentetea tripartiti*
12. *Littorelletea, Utricularietea intermedio-minoris*
13. *Montio-Cardaminetea, Adiantetea*
14. *Potamogetonetea*
15. *Corynephoretea*
16. *Asteretea "tripolium", Juncetea maritimi*
17. *Thlaspietea rotundifolii*
18. *Elyno-Seslerietea*

R. S.

TAKHTAJAN, A.: Evolution und Ausbreitung der Blütenpflanzen. VEB G. FISCHER Verlag, Jena 1973, 190 pp.

The works of TAKHTAJAN serve as a basis for the up-to-date systemization of phanerogams (to mention only the publications in foreign languages: Die Evolution der Angiospermen, Jena 1959; Flowering Plant Origin and Dispersal, Edinburgh 1968; and the present work). Thus my own system (1953, revised in 1967) was also based on them (and also on other Soviet authors'). His systemization was further developed by CRONQUIST (The Evolution and Classification of the Flowering Plants, Boston 1968), and by EHRENDORFER (in Strasburger Lehrbuch der Botanik, 30th ed., Stuttgart 1971); for the review of this latter see Acta Bot. Hung. 8, pp. 431—2. — On the basis of all these, and of the recent chemotaxonomical results, I have attempted to modernize my system (Synopsis florae veget. syst.-geobot. Hungariae V. pp. 521—32; 1973; Taxon 1974).

This latest work of the author is a slightly modified edition of his work entitled Происхождение и рассеяение цветковых растений, 1970 (the today's floristic plant-geographic division of the earth has not come about). The various chapters discuss the following spheres of problem: Genetical and ecological factors in the evolution of the flowering plants (emphasis put on the role of neoteny and of insects); the theoretical reconstruction of first flowering plants (the development of the vegetative organs and flower is discussed one by one); the origin of monocotyledons (the author considers these a group of uniform descent and — as also myself — traces them back through *Alismales* to *Nymphaeales*). Further chapters investigate the causes of dispersion on a large scale of the flowering plants in the Cretaceous, then search for their probable centre of origin between Assam, South-China and the Fiji Islands — on the area earlier called Kathaysia by the author — and deny the arctotertiary origin; finally, the differentiation of floral plants in the Cretaceous, and the development of tertiary phytochores are discussed. The Appendix is a recent survey of the author's system. He divides the first class (dicotyledons, *Magnoliopsida*) of Angiosperms ("*Magnoliophyta*") into 6 subclasses: *Magnoliidae*, *Ranunculidae* (earlier, and with others they belong to one subclass), *Hamamelididae*, *Caryophyllidae*, *Dilleniidae*, *Rosidae*, *Asteridae*, with altogether 15 superordos and 73 orders. The monocotyledons are divided into 4 subclasses: *Alismidae*, *Liliidae*, *Commelinidae*, *Arecidae*, with 5 superordos and 20 ordos. Cf. the modified system of the Ref., Synopsis and Taxon, l.c., where the subclasses and their order is as follows: *Dicotyledonopsida* ("*Magnoliatae*"), *Magnoliidae*, *Rosidae* (incl. *Hamamelidales*), *Dilleniidae* v. *Malvidae*, *Caryophyllidae* and *Eucomiidae* ("*Hamamelididae*" p. maj. p.), the ordos of the *Asteridae* sympetal connect partly to

the *Rosidae*, and partly to the *Malvidae*. *Monocotyledonopsida* ("*Liliatae*"): *Alismatidae*, *Liliidae* (incl. *Commelinidae*), *Arecidae*.

TAKHTAJAN's new book is an excellent short survey of the development and system of flowering plants. Similarly as the Ref., his taxonomical manuals are based on monophylia; he search for the descendency of flowering plants in such old Angiosperm groups in which the secondary primitive xylem consisted of tracheae with stepwise thickening, and which had primitive hermaphroditic strobili (it is from these that the strobili of *Bennettites*, and the flowers of Angiosperms might have descended). The Ref. (1953) joined to these views explored already as early as 1948—1950, but, as many others, TAKHTAJAN also considers Pteridosperms as final common primogenitor.

R. Soó

WINTERL, J. J.: Index Horti Botanici Universitatis Hungariae, quae Pestini est. 1788. (The first floristic work from Central Hungary. Postscript to the facsimile edition of WINTERL's Index compiled in 1788 by Sz. PRISZTER). Akadémiai Kiadó, Budapest, 1972, 120 pp. + 25 tabs; postscript 25 pp. + 4 figs.

It was JAKAB JÓZSEF WINTERL, Upper-Austrian by origin the founder and up to 1809 the director of the first Hungarian botanical garden — which in 1777 was moved from Nagyszombat (Tyrnavium, Tyrnau, today Trnava, ČSSR) to Buda, then in 1784 to Pest — who first noticed the particular features of the Pannonian flora deviating from the Central European flora, and who named or described some seventy species, in his seed-exchange index published in 100 copies in 1788. Although these special plant, deriving partly from the sand and alkali soils of the Great Plains partly from the barren limestone and dolomite hill-sides of the Central Range were later introduced in taxonomy not with WINTERL's name as author, their recognition and separation were such important act in the the history of science as made this work the first one on the flora of Central Hungary. Thus it is a related yet appropriate acknowledgement of WINTERL's merits that — on the occasion of the 200th anniversary of the Botanical Garden of the Budapest University — the facsimile bibliophile edition of this rare work of source value, of which only a few entirely unimpaired copies have survived up to present times, has been placed on our desk, as a real masterpiece of book-art by the Publishing House of the Hungarian Acedemy of Sciences.

The Index, consisting of 112 pages (the parts containing U-V-Z entries were not published even at the Index's own time), enumerates, following an introduction of six pages in Latin 900 home plant species, 750 foreign plant species, among them 150 hothouse plants, accompanied by a short description in most of the cases. This is followed by 25 artistic copper-print plates the fascinatingly beautiful drawings of 26 species, the works the ratio of 21: 5 by ANTON TISCHLER and AUGUST MEYER, graphic artists in Pest. It is SZANISZLÓ PRISZTER, the present head of teh Botanical Garden, who deserves the merit for the detection of the printing boards and the finding of WINTERL's portrait, which has been hiding unknown until now. He was also the one who with an expert's thoroughfulness wrote the enclosure, a study in English, which is a reliable, conscientious, and exemplary elaboration of all the contemporary historical, biographical and nomenclature information related to the Index and all based on independent research. Its main merit is the satisfying identification of the 26 species illustrated in the Index, and of a further 20 species which have not been copper-printed, as well as that of 46 species which were indicated as "novus" by WINTERL (there are only 7 species whose identification remains uncertain !). The usability of the Index is enhanced by two name indexes (one leading from the old names to the ones valid today, and another the other way round). This leather-bound facsimile edition in gilded overprinting is an important source-book, it documents the early high level of Hungarian science, and the pretentiousness of our present book-publishing as well.

I. CSAPODY (Sopron)

H. KOBLITZ: Zell- und Gewebezüchtung bei Pflanzen. G. FISCHER Verlag, Jena 1972. pp. 1—84. 10 figures and 3 tables; with 20 photographs on 6 plates.

Cultivation of plant tissue went today far beyond the age of technique attempts and biological peculiarities. Today it constitutes an indispensable and inevitable field of research into plant cell, tissues and organs, concerning not only methods but also direction. The book deals with this field, and the author himself is a research-worker in plant tissue cultivation, and has enriched our information on the subject by having clarified the details of the mechanism of lignin synthesis.

The work briefly summarized informations necessary for those working in this field and for workers in plant physiology in connection with the cultivation of isolated plant parts. After a short introduction, the work surveys the history of this discipline (Chapter 2), and then treats in the methodological part the role of nutrient media, culture vessels, instruments and installations, the sterilization of nutrient media, culture vessels and plant material, the process of isolation, and the role of physical conditions necessary for incubation (Chapter 3). The principles and conditions of *in vitro* growth and development of the test objects, the individual organs, tissues and the various cell preparations are discussed in Chapter 4, while Chapter 5 deals with the application of the cultures, e.g. production and biosynthetic potential, genetical, vegetative plant reproduction and phytopathology. The work is complemented with a short list of references, and with a name and a subject index.

The greatest merit of the work is its concise and clear posing of the problems, the presentation of results achieved so far, and the showing of expectable trends of development. Following from the restricted nature of the volume, certain fields are touched upon only briefly, this counts however — in this age of information surge — as an advantage rather than a disadvantage.

Owing to its up-to-date treatment of the subject and of its concise imparting of information, I consider this work a gain to the special field. I can highly recommend it as an excellent compendium to both those working in this special field and the plant physiologists, as well as to all those interested in the problems of tissue cultivation.

M. MARÓTI

PÁL GREGUSS: Xylotomy of the living conifers (808 microphotos on 175 plates and 145 plates with drawings. Akadémiai Kiadó, Budapest 1972)

The author's great monography, entitled *Az élő nyitvatermők meghatározása szövettani alapon* (Xylotomy of the living conifers), was published in English and German, in 1955. It was adjudged "the most beautiful book" of the year, and the author was awarded the silver grade of KOSSUTH prize. The specialists of five continents expressed their high appreciation of this work, not only on account of its layout, but also in respect of its contents (e.g. at the International Book Fair, Leipzig).

In this work, the author worked up the wood anatomy of 65% of some 550 recent coniferous species, in a way to allow an accurate identification of the various species even from minute samples.

Recently the examination of increasingly more home and foreign fossil woods and other prehistoric plant remains has become necessary. It is justifiably expectable that in determining the fossil wood findings botanists primarily should be at our assistance. Along with other remains, numerous prehistoric coals, old wooden tools of man, old wooden statues, etc. come to light, the determination of which also waits for xylotomists. Archeologists can draw valuable conclusions from the results of determinations. In addition to these implications of social history, the great theoretical and practical importance of the work should also be mentioned

(its use in the history of plant evolution, plant geography, climatology, geology, paper- and furniture industry, and often even in courts of justice). That is why literature received the book with great appreciation. (An English periodical, for example, wrote as follows: „It is a wonderful publication. The Hungarian Academy of Sciences should be congratulated in bringing out this wonderful book with rich illustrations." — An Austrian monthly judged it in the following words: "Zusammenfassend: Eine Meisterleistung, zugleich eine unerhörte Arbeitsleistung.").

After the favourable international appreciation of the work, the author decided that for the sake of completeness an attempt should be made to obtain and elaborate the heterofore untreated coniferous species. His endeavour met with success, and by the unrelenting work of 15 years, he obtained and elaborated wood samples of a further 160 coniferous species. (we know from the book that the author received material from some 30 countries of the world; for example, he obtained the smallest coniferous tree of the world from the alpine areas of New Zealand; it hardly grows higher than 30—40 cm, while its "trunk" is merely 1—2 mm thick). Several thousand microscopic slides have been made from the wood samples, which were then used for taking artistic photographs and drawings, and, similarly as in the first volume, here again characterization of each species has been submitted. This volume is thus an organic continuation of the author's first great monograph, and the two together make a detailed anatomical work of conifers which is unequalled in world literature. The author treated 505 species in the two volumes together, that is, more than 90% of all coniferous species.

Incidentally, this is the tenth considerable volume in wood anatomy published by the same author in Hungarian, German, English and Russian.

The book runs to 502 pages. In the introduction the author gives a brief account on the circumstances of publication, expresses his acknowledgement to the institutions and specialists who helped in the obtainment and elaboration of the material.

Subsequently, the work divides into two parts. In the General Part the anatomical construction of the four main types is reviewed and illustrated with artistic drawings in perspective; the characteristics on the basis of which the four main types can be distinguished are given special emphasis.

In the Special Part, some *Cycas* species related to conifers are discussed in a separate chapter — for the sake of comparisons, — then the various coniferous families, genera, and species are treated on the basis of the distinguishing characteristics. When discussing the species, the author gives the distribution of the examined species and the source of his material.

The method of elaboration is consistent, and this raises the value of the book. It was László Siprák, laboratory assistant, who helped in making the xylotomic sections, and 4 demonstrative photographs were taken of the species sections each. The author took the photographs, while the drawings praise the skill of Lenke Gosztonyi, laboratory technician, and of Dr. Margit Szabados, teacher, both co-workers of the author, under his supervision. The text is complemented with rich literature, a combined Index directs to the description and the demonstration material of the species elaborated in Volumes I. and II. The greatest value and thus scientific and practical importance of the work is that recent and fossil coniferous species can be identified also by a fragment of their substance.

The layout of the work is praiseworthy, the paper for the text and of the 320 plates is also excellent, herefore this latest work of the author is a highly meritorious addition to his former books of similar nature. They have brought great appreciation from all over the world to both the Publishing House and Hungarian science. The publication of a book like this be hailed only with congratulations.

I. Horváth

JOURNAL OF PALYNOLOGY

We are pleased to announce that with the inauguration of the new series of the Journal of Palynology commencing with Vol. VIII, 1972, we have been appointed by the Palynological Society of India as the Printers and Publishers of this Journal. We have also been appointed distributors for the back volumes. The difference in the old and new series is that the material until now published by the Palynological Bulletin will be merged in the new journal under the head "*Palynological Communication*" *(A CONTINUATION OF THE PALYNOLOGICAL BULLETIN)*. It is intended that the new series will be issued twice a year, in July and December.

The scope of the *JOURNAL OF PALYNOLOGY* established in 1966 by the Palynological Society of India covers promoting the dissemination of palynological knowledge involving all aspects of pollen spore studies from algae to angiosperms, of both present-day and fossil plants. The research papers published in the journal cover a variety of topics in the various fields of *BOTANY* (morphology, embryology, systematic botany, cytology and genetics, palaeobotany), *AGRICULTURE* (floral biology, pollination ecology, crop taxonomy, etc.), *GEOLOGY* (coal and lignite stratigraphy and correlation, palaeoclimate and palaeogeography, etc.) and *MEDICINE* (pharmacognosy, allergy, etc.). Apart from the above general fields of interest, we would be interested in chemotaxonomy, bee-botany, and biochemistry. It can be seen therefore, that the treatment of subjects in the journal is of an interdisciplinary nature.
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РЕЗЮМЕ

БРИОГЕОГРАФИЧЕСКОЕ ИЗУЧЕНИЕ КАРСТОВОЙ ОБЛАСТИ БИХОРСКИХ ГОР

А. БОРОШ и Л. ВАЙДА

Бихорские горы представляют собой одну из самых интересных частей Трансильванских Карпат. Очень богатую и интересную флору явнобрачных этой местности впервые изучал Пал Китайбел, а затем А. Кернер. Ее бриофлору же изучал М. Петерфи (в 1908 году). В период проведения последних исследований карстовые образования данной территории были почти недоступными и, следовательно, они по большей части оставались неизвестными. Карстовые явления этих гор открыл и впервые изучал Д. Царан (1905 г.).

В 1972 году на этих малоизвестных и очень интересных карстовых образованиях авторы изучали бриофлору во время совместной экскурсии в Трансильванию. В настоящей статье обсуждается флора мхов: 1. скеришорской ледяной пещеры, 2. карстового источника Избук-Понор и падышского катавотра, 3. ущелья Теплого-Самоша, 4. Драконовой пещеры у села Ончаса и 5. пещеры Пештера Шури.

ПРИМЕЧАНИЯ К АНАТОМИИ ЛИСТЬЕВ КОМПЛЕКСА ВИДОВ BRACHYPODIUM PINNATUM

О. С. БОРШОШ

Автор изучала на основе лишенной кожицы пластинки и поперечного сечения 56 листьев анатомическую структуру видов ***Brachypodium pinnatum*** и ***B. rupestre*** и установила, что два таксона отличаются друг от друга, наряду с различными внешними морфологическими признаками, также в отношении анатомического строения листьев. Форма склеренхимной ткани, появление и форма кремневых клеток, картина эпидермиса показывают выраженные различия. Следовательно, обособление указанных двух таксонов в качестве видов вполне обосновано.

AGROSTIO–QUERCETUM ROBORI CERRIS ЛЕСА НА МАЛОЙ ВЕНГЕРСКОЙ НИЗМЕННОСТИ

И. ЧАПОДИ

На плиоценовых и плейстоценовых галечных террасах Малой венгерской низменности (**Arrabonicum**) развился своеобразный тип скелетных почв, так называемая Чери-почва, для которой характерны водонепроницаемый псевдоглеевый слой и сцементированный горизонт гравия меняющейся мощности. Водный баланс этих почв меняется: от осени до весны они влажны, а в период вегетации они совершенно сухи, покрыты трещинами. Их своеобразными лесами являются смешанные с черещатым дубом леса чернильного дуба, названные автором раньше ***Quercetum robori-cerris arrahonicum.*** В настоящей статье дается описание новой лесной ассоциации под названием ***Agrostio-Quercetum robori-cerris.*** Автор дает также первую разработку сообщества в виде таблицы, из которой видно, что оно в пределах серии ***Quercetalia pubescentis*** и относится к группе ***Quercion pubescenti-petéaeae.*** Из множества разрушенных рудеральных растений видно, что образователями типов являются ***Agrostis tenuis***, ***Festuca rupicola***, ***Briza media***, ***Poa angustifolia***, ***Calamagrostis epigeios.*** В флористическом составе сообщества участвуют ксерофильные, гидрофильные и ацидофильные виды. Его внешний габитус рощевый, на полянах массовое

появление *Juniperus communis* хранит следы многовекового выпаса скота. На территории Praenoricum новая ассоциация находится в контакте с близкородственной ассоциацией *Deschampsio-Quercetum robori-cerris*, а на территории флористического района Praeillyricum — с сообществом *Asphodelo-Quercetum robori-cerris*.

ГОРМОНАЛЬНОЕ РЕГУЛИРОВАНИЕ НУКЛЕАЗ В РАСТЕНИЯХ

Г. Л. ФАРКАШ

Листья сеянцев *Avena sativa* L. содержат несколько нуклеолитических ферментов Четыре из них были изолированы, очищены, охарактеризованы и количественно определены в контрольных листьях и в листьях, обработанных гормонами (кинетин, абсцизинная кислота). Было доказано, что не все исследовавшиеся нуклеазы реагируют на действие гормонов. Абсцизинная кислота стимулирует в молодых листьях образование неспецифической для сахара нуклеазы, которая в нормальных условиях в тканях молодых листьев была выявлена только в незначительном количестве. Эта же нуклеаза становится главным нуклеолитическим ферментом в листьях овса в ходе естественного старения листовой ткани.

ТЕПЛОУСТОЙЧИВОСТЬ КАТАЛАЗЫ В ДРОЖЖЕВЫХ КЛЕТКАХ

В. ФРЕНЬО

В прежних работах автор проводил опыты со свежими и сушенными дрожжами по выявлению каталазной активности, чтобы сделать заключение о наличии микроорганизмов. В исследуемых в отношении гигиены образцах (питьевая вода, прохладительные напитки, масса для мороженного и т. п.) в качестве модели вместо других микроорганизмов использовались дрожжи. Для проведения исследований пришлось выяснить, какое изменение вызывает температура в катализной активности. При температуре в 20°С в водной суспензии каталазная активность дрожжей на протяжении примерно 3 часов остается почти неизменной. При повышении температуры активность резко понижается и при температуре в 60°С она прекращается в течение нескольких минут. Полученная величина совпадает с общепринятыми для ферментов температурными величинами, при которых белки коагулируют (за исключением теплоустойчивых микроорганизмов). При длительной температуре в 45°С активность водной суспензии дрожжей понижается, вначале быстро, а затем постепенно замедляясь. Однако эту активность можно выявить еще и по истечении 3 часов.

ДАННЫЕ К НАПРАВЛЕНИЮ ВРЕМЕНИ БИОЛОГИЧЕСКОЙ ЭВОЛЮЦИИ

А. Ш. ГАРАИ

Биологическая эволюция имеет направление времени, которое повидимому противоположно направлению времени, предписанному вторым законом термодинамики. В связи с анализом этой проблемы дается краткий обзор направления времени в физике и выдвигается гипотеза, согласно которой в биологическом транспорте электронов спиральная поляризация связана с направлением времени биохимических процессов. Теорема CPT служит теоретической основой для этого предположения. Указанная проблема была экспериментально изучена методом позитронного уничтожения L-аминокислот и их D-изомеров в кристаллической форме.

ОКОНЧАТЕЛЬНЫЕ РЕЗУЛЬТАТЫ ЭКСПЕРИМЕНТОВ ПО ПОВЫШЕНИЮ КОЛИЧЕСТВА ВОЛОКОН КОНОПЛИ (CANNABIS SATIVA L.)

А. ХАРАСТИ

Автором в течение десяти лет непрерывно проводились эксперименты по повышению количества волокон конопли. Результаты опытов, проводившихся в период от 1961 до 1964 годов при сотрудничестве Кестхейского Вуза аграрных наук и в период от

1965 до 1970 годов при сотрудничестве Южноальфельдского Сельскохозяйственного Научного Института, показывают, что из химических удобрений, содержащих макро- и микроэлементы, применявшихся в ходе экспериментов в 50 различных комбинациях, наиболее эффективными оказались калиевые, марганцевые и магниевые удобрения. Эти удобрения использовались для заключительных экспериментов, результаты которых оценены соответственно правилам математической обработки. Выяснилось, что под влиянием минеральных удобрений, содержащих магний, марганец или калий и магний, были получены достоверные отклонения, по сравнению с контролем, и при помощи этих удобрений удалось добиться увеличения количества волокон на 27—32%. В то же время при применении калиевых и калий-марганцевых удобрений также было выявлено увеличение количества волокон на 15—17%. С точки зрения народного хозяйства это можно считать значительным достижением.

ИЗУЧЕНИЕ СОСТАВА РАСТИТЕЛЬНЫХ СООБЩЕСТВ ЗАСОЛЕННЫХ ПОЧВ В ФИТОТРОНЕ

И. ХОРВАТ и Д. БОДРОГКЁЗИ

Авторы изучали структуру состава 5 растительных сообществ засоленных почв, увеличение сухого веса и использование энергии в фитотроне. Сильное отклонение, наблюдавшееся по использованию энергии в отдельных составах (от 0,4 до 1,6%), указывает на связь процентного соотношения злаков с содержанием пигментов в господствующих видах.

СРАВНИТЕЛЬНЫЙ МОРФОЛОГИЧЕСКИЙ ПЫЛЬЦЕВОЙ АНАЛИЗ У ВИДОВ FUNARIA И PHYSCOMITRIUM

М. ЯРАИ-КОМЛОДИ

Сообщается результат сравнительного морфологического изучения пыльцы нескольких видов ***Funaria*** и вида ***Physcomitrium pyriforme.***

На основе морфологических отклонений пыльцевых зерен **Funaria hungarica** от пыльцы **Physcronium pyriforme** вид **Funaria hungarica** относится к роду **Funaria.**

ПРИМЕНЕНИЕ ИНДИКАТОРНОЙ КОНЦЕПЦИИ TWR НА ВОДНЫЕ И ПОЙМЕННЫЕ ЭКОСИСТЕМЫ

И. КАРПАТИ, и В. КАРПАТИ

Показание местообитания было, соответственно индикаторной концепции показателей TWR, анализировано отвлеченно от видов, с помощью математико-статистических методов, и использовано как информация, получаемая из закономерностей экосистем. Анализ, проводившийся на основе средних величин, полученных от данных многочисленных ценологических съемок и представленных в съемках видов, представляет более многостороннюю информацию. Использование индикаторной ценности важнейших экологических факторов (температура, водный режим и химическая реакция) в отношении биоединиц или ценозов может давать очень полезные информации для синэкологических исследований, как было показано на примере водных и пойменных биоединиц. Полученные данные представляют собой также отправную точку для водного хозяйства.

ИНДИКАТОРНАЯ ЦЕННОСТЬ ЛУГОВЫХ СООБЩЕСТВ И ДОМИНИРУЮЩИХ РАСТЕНИЙ В КОНТАКТНЫХ АССОЦИАЦИЯХ В ОТНОШЕНИИ ПОЧВЫ

М. КОВАЧ

Обсуждаются условия почвы сообществ ***Juncetum subnodulosi*** и находящихся с ними в контакте луговых сообществ, а также проблематика индикаторной ценности доминантов в отношении почвы.

НОВОЕ ОБЬЯСНЕНИЕ ФОРМИРОВАНИЯ ЦЕНТРОВ ГЕНОВ

Д. МАНДИ

С помощью прежних методов лингвистики, археологии и других методов исследования удалось выяснить места происхождения, ход развития и т. д. культурных растений. Вавилов изучал эту проблему исходя из живого материала. Выдвинутые им центры генов представили предполагаемые места возникновения. Все эти центры располагаются между 25—35° с. ш. Позже центры генов были расширены в «макроцентры».

По представлению автора настоящей статьи центры генов Вавилова следует рассматривать как первобытные местообитания. Макроцентры же указывают уже на путь дальнейшего развития. Формированию центров генов по Вавилову благоприятствовало географическое расчленение, то, что на указанных территориях имеются плоскогорья высотой от 1000 до 3000 м. Высота над уровнем моря умеревала более южное расположение, благодаря чему могли формироваться также культурные растения более северных территорий умеренного пояса, как напр. пшеница, горох, лен и т. п. Благоприятное географическое положение обеспечило возможность для «открытия» растениеводства, а также для начала ухода за соответствующими видами культурных растений.

ДЕЙСТВИЕ ГИДРОЛИЗАТОВ КАЗЕИНА НА РОСТ КАЛЛЮСА В РАСТЕНИЯХ ТАБАКА (NICOTIANA TABACUM L.)

М. МАРОТИ

Автором было изучено действие различных препаратов гидролизата казеина (ампарон, аминозоль, аминофузин) на рост каллюса растений табака (*Nicotiana tabacum* L.). Изолированные вторичные культуры выращивали в течение четырех недель в темном термостате при температуре в 28 °С на модифицированной плотной питательной среде Готере (1959 г.) и Мурашиге-Скуга (1962 г.), содержащей также гормональные стимуляторы (IAA, 2,4—D, кинетин, GA, CM). Показатели роста каллюса определяли на основе повышения свежего и сухого весов, а также изменения числа клеток. Авторы вычислили кроме того суточную и относительную величину роста каллюса. Экспериментальные данные были получены в результате статистической обработки.

Результаты опытов показывают, что наряду с гормональными регуляторами, представляющими первичные регуляторы роста изолированного каллюса табака, различные гидролизаты казеина выполняют роль вторичных регуляторов, так как они способны повысить или понизить действие первичных регуляторов. Из исследовавшихся препаратов гидролизатов казеина стимулирующее действие ампарона и аминозоля оказалось более выраженным. Влияние аминофузина было только умеренным, что повидимому связано с содержанием в нем сорбитола. Проявление действия этих препаратов всегда зависит от основной питательной среды, вернее от соотношения гормональных веществ, содержащихся в питательной среде.

ИЗУЧЕНИЕ БИОКЛИМАТА В ГОРАХ УЛУГУРУ (ТАНЗАНИЯ, ВОСТОЧНАЯ АФРИКА)

Т. ПОЧ

Анализ микроклимата естественного и вторичного растительного покрова гор Улугуру в прибрежной области Танзании является частью комплексной работы по изучению биосферы, проведенной автором с 1969 по 1973 гг. Целью работы является описание естественной растительности и ее флористического состава, выявление распределения описанных единиц растительности при помощи подробной картографии и определение ограничивающих факторов окружающей среды. После выяснения важнейших факторов, регулирующих распределение единиц растительности, автор намеревается сделать попытку установить сельскохозяйственный потенциал каждой единицы естественной площади на основе ее растительности.

В настоящей статье обсуждается микроклимат четырех естественных растительных сообществ, произрастающих на северо-северо-западном склоне горы Бондва, и данные сравниваются с данными вторичной растительности на соседних территориях, занятых главным образом кукурузой. Этот период без дождей был особенно пригодным для изучения биоклимата, так как стояла ясная и теплая погода, растительность с опадающей

листвой открытых лесистых местностей находилась в оптимуме своего развития, деревья еще не были безлистными и, следовательно, микроклимат можно было сравнивать с микроклиматом лесов.

ОСНОВНЫЕ ВОПРОСЫ ОНТОГЕНЕЗА РАСТЕНИЙ

Ш. ШАРКАНЬ

В введении к статье автор дает краткий обзор исторически важных начальных этапов изучения и толкования онтогенеза растений, выдвигая большие заслуги Гофмейстера в открытии регулярного чередования двух различных способов размножения (смена поколений), характерных для жизненного цикла **Embryophytae**. В дальнейшем сообщается сущность новых исследований, полученных результатов и противоречий в толковании, наблюдаемых через десятилетия после деятельности Гофмейстера вплоть до наших дней. Некоторые из этих данных автор подвергает критическому анализу: в том числе обсуждает дефиницию индивида, современное толкование смены растительных поколений, своеобразную номенклатуру Виддера, чередование форм вегетативного тела в пределах жизненного цикла, критические этапы онтогенеза **Fucus**, некоторые примеры прерывистого и непрерывного онтогенеза и, наконец, оспариваемую обоснованность существования двух фаз спорофитов (**Embriosporofiton-Tetrasporofiton**), введенных Виддером для семейства **Angiospermae**. В заключение автор подвергает критике мнение Штибера, согласно которому эндоспермии **Angiospermae** представляют собой третью фазу онтогенеза.

ИЗУЧЕНИЕ РАЗВИТИЯ И РОСТА ВИДОВ BRACHYPODIUM SILVATICUM И EUPHORBIA CYPARISSIAS В ДУБРАВАХ

Й. СУЙКО-ЛАЦА и Г. ФЕКЕТЕ

В 1970 и 1971 гг. авторы проводили фенометрические исследования на двух многолетних растениях ксеротермофильного дубового сообщества. ***Brachypodium silvaticum*** и ***Euphorbia cyparissias*** относятся к тем видам сообщества, которые зимуют с минимальной ассимилирующей поверхностью. Следовательно в вегетационный период они способны к ассимиляции, опережая виды с геофитонным образом жизни. У вида ***Brachypodium*** возобновление начинается немедленно после окончания фазы воспроизведения, а у вида ***Euphorbia*** через 2—3 месяца после опадения плодов. В случае ***Brachypodium*** фаза воспроизведения и максимумы **RGR** в годы исследования появились на месяц позже, чем у вида ***Euphorbia***. У последнего вида процесс роста менее равномерный, чем у вида ***Brachypodium***. В 1970 году величины **NAR** и **RGR** стали отрицательными уже к концу мая, и в июле, вследствие активности стерильных боковых побегов, они вновь стали положительными, а затем опять отрицательными. ***Brachypodium silvaticum*** отличается более равномерным ростом, хотя в 1970 и 1971 гг. его рост не был одинаковым. В 1970 году величины **NAR** и **RGR** стали отрицательными только в сентябре, а в 1971 году — предположительно под влиянием факторов среды, отличающихся от условий предыдущего года — они стали отрицательными уже в июле. Вид ***Euphorbia*** достиг максимального коэффициента относительного роста в обоих годах путем максимальной величины **NAR**. У вида ***Brachypodium*** достижение максимальной величины **RGR** не обязательно связано с максимальной величиной **NAR**. Этот вид может достигнуть максимума **RGR** и в связи с максимальной величиной **LAR**. Тем не менее, на основе данных 1970 и 1971 гг., у этого вида между коэффициентами **NAR** и **RGR** наблюдается достоверная корреляция.

ДАННЫЕ К ХЕМОТАКСОНОМИИ СЕМЕЙСТВА BORAGINACEAE

П. ТЕТЕНЬИ

По данным газохромографического исследования для семейства ***Boraginaceae*** (40 видов, 88 образцов семян) — за исключением ***Heliotropioideae*** — характерно присутствие гамма-линоленовой кислоты и октадекатетраеновой кислоты. Отклонения в пределах вида наблюдались как в отношении гамма-линоленовой кислоты, (**Borago officinalis**) так и тетраеновой кислоты (***Lappula squarrosa***). Причисление родов ***Alcanna***, ***Asperugo*** и ***Caccinia*** к трибам ***Anchuseae***, ***Eritrichieae*** или **Cynoglosseae** необосновано. От древнего семейства **Heliotropioideae** больше всего дифференцировалось — на основе максимального содержания ненасыщенных жирных кислот — семейство ***Lithospermeae***. В отноше-

нии же удлинения углеводной цепи (22 : 1) максимальное отклонение показывает таксон *Cynoglosseae*. Остальные таксоны, относящиеся к этому семейству, автору удалось — сообразно с этими тремя крайними точками — хемотаксономически классифицировать.

ДАННЫЕ К НОВОЙ ЦЕНОСИСТЕМАТИЧЕСКОЙ КЛАССИФИКАЦИИ POLYGONION AVICULARIS BR.—BL. 31.
ЧАСТЬ 1

Г. УБРИЖИ

Из встречаемых в Венгрии 8 сообществ сорных растений, относящихся к группе ассоциаций *Polygonion avicularis* Br.—Bl. 31. автором обсуждается в настоящей статье только одна новая рудеральная ассоциация, обнаруженная на Балканах (напр. в Болгарии) и в Италии, называемая Euphorbio (supinae)—*Polygonetum herniarietosum* Ubrizsy 55/72.

Это сообщество все чаще появляется прежде всего на мостовых, шлаковых и обычных тротуарах и обочине дорог в городах (напр. в Будапеште с 1950 года). В г. Сегед Тимар эта ассоциация обнаружена уже в 1946—1950 гг.

Общее число видов сообщества 85; из них 61 вид можно рассматривать как виды, связанные с данной ассоциацией. Экологические и ценоструктурные характеристики этой ассоциации следующие: биоэкологический спектр: Th: 65,7%; TH: 5,9%; H: 25,5%; G: 2,9%;
флористический спектр: адв., 15,7%, косм.: 17,7%; Ср.: 9,8%; евра.: 50,0%; ев.: 1,9%; средиз. (субсредиз.); 4,9%; конституционный спектр: K5: 2,3%; K4: 7,0%; K3: 8,2%: K2: 26,0%; K1: 56,5%.

КОМПЛЕКСНЫЙ АНАЛИЗ ГЕНОМОВ ЕВРОПЕЙСКОГО ВИДА CYSTOPTERIS FRAGILIS

I. Тетраплоидные таксоны

Г. ВИДА

На основе анализа мейоза синтетизированных гибридов и индуцированных апогам ных растений можно установить, что 4x *C. fragilis* и 4x *C. dickieana* являются аллотетраплоидными таксонами, которые не имеют общего генома с *C. protrusa* (2x). *C. fragilis* 4x участвует также в гексаплоидных таксонах *C. fragilis* и *C. regia*. Он имеет общий геном также с *C. dickieana* 4x. Следовательно в происхождении двух тетраплоидных таксонов повидимому участвуют 3 неизвестных диплоида. Самопроизвольная соматическая полиплоидизация, вызванная апогамией вида 2x C. fragilis. демонстрирует возникновение 4x C. fragilis

ИЗУЧЕНИЕ ПРОДУКТИВНОСТИ РАСТИТЕЛЬНОСТИ НА ОПЫТНОМ УЧАСТКЕ IBP У СЕЛА УЙСЕНТМАРГИТА

Б. ЗОЙОМИ, И. МАТЕ, И. ПРЕЧЕНЬИ и З. СЮЧ

Подытоживаются результаты исследований первичного производства, проведенных в период от 1967 до 1971 года на опытном участке IBP у села Уйсентмаргита, в лесу «Тилош эрдё» на северо-западном краю Хортобади. Эта территория как в прошлом, так и в настоящее время была покрыта мозаичной растительностью лесостепного характера. Исследовавшиеся растительные сообщества следующие: в сообществе *Galatello-Quercetum roboris* была изучена продукция листвы и поросли (надпочвенных и подпочвенных частей) в фации *Polygonatum* и *Poa*; а также в сообществах *Peucedano-Galatelletum* punctati; *Arbemisio-Festucuetum pseudovinae*, *Achilleo-Festucetum pseudovinae* (использованных и неиспользованных в качестве пастбища) и в полевых культурах. В полевых культурах исследования проводились с 1967 по 1969 гг. Обсуждается средняя продуктивность, эффективность, время обмена веществ и темпы производства. Авторы занимаются также объяснением границы леса на изучаемой территории.

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EFFECT OF BROMACIL TREATMENT ON THE SYNTHESIS OF NUCLEIC ACIDS AND FLOWER FORMATION IN PHARBITIS NIL

By

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(Received: November 26, 1973)

It was possible in a previous work to reduce flower bud formation of apple trees by bromacil (5-bromo-3-sec. buthyl-6-methyluracil). It remained problematical, however, whether a reduction in flower bud formation of apple trees was a real selective inhibition of flower formation. Hence the effectiveness of bromacil was tested in seedlings of *Pharbitis nil.*

Six day old seedlings were treated, immediately before the inductive dark period, with bromacil and after the dark period incubated by ^{32}P-orthophosphate. Nucleic acids were extracted then separated by MAK-chromatography. Eight plants for each treatment were further grown in continuous light in order to establish flower formation.

RNA synthesis vegetative development and flower formation of in seedlings *Pharbitis nil* Chois. Strain "Violet" is non-specifically inhibited by bromacil. Since its effects on vegetative growth and on flower formation cannot be separated, the reduction in flower formation may not be considered as a real selective inhibition.

Introduction

It has been known for more than ten years that flower formation in higher plants can be inhibited selectively by base analogues of nucleic acids (HESS 1959, HESLOP-HARRISON 1960, ZEEVAART 1962). Recognizing these papers, attempts were made at reduction of flower bud formation of apple trees by an uracil derivative (5-bromo-3-sec.buthyl-6-methyluracil). In a previous paper (BUBÁN 1969) we reported some results and outlined the object of our experimental work. It remained problematical, however, whether a reduction in flower bud formation of apple trees was a real selective inhibition of flower formation. Apple as a deciduous tree is rather unsuitable for the investigations required in solving of this problem. The efficiency of our preparation was, therefore, checked in seedlings of *Pharbitis nil.*

Materials and methods

Seeds for growing the experimental plants came from Japan (Marutane Trading Co. Ltd.). The plants (*Pharbitis nil* Chois., Strain "Violet") were grown on the basis of TAKIMOTO's (1969) collective works. Seeds were planted after a pretreatment with conc. sulfuric acid followed by washing in running warm water.

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Growing seedlings were continuously illuminated by Osram-L Interna strip lightings with intensity of 1800 Lux at the level of cotyledons. On the sixth day after planting, immediately before the inductive dark period, plants were treated with 5-bromo-3-sec. butyl-6-methyluracil which is the active ingredient of a Du Pont herbicide (Hyvar X-WS). 5×10 microlitre of the solution was applied on each cotyledon of the plants by means of an EPPENDORF pipet; the total amount of the active compound on the plants was 0.1 micromole each. Distilled water containing 5 per cent of methanol and 0.1 per cent of Adhäsit 8013 surfactant was used as solvent. Control plants were treated with this solvent. After the inductive dark period (1×16 hours) seedlings were cut to uniform stem length then pulse labelled with ^{32}P-orthophosphate (Amersham Buchler) by dipping the cut surface of the stem into acetate buffer (0.05 M, pH 5.0), containing 0.5 mC/ml. Incubation occurred immediately after dark period, at light and 26 °C, 2 hours.

Nucleic acids were extracted from 3 pairs of ^{32}P-incubated and 3 grams of inactive cotyledons for each treatments. Extractions were carried out by a system of water-saturated phenol and tetrasodiumpyrophosphate (in Tris-HCl buffer of pH 7.5). Full details of MAK-chromatographic separation of nucleic acids were given in a previous paper (SEITZ and RICHTER, 1970).

Fractions obtained from the automatic fraction collector were remeasured by a ZEISS-Opton spectrophotometer and a Tri-Carb Liquid Scintillation Spectrometer (Packard Mod. 3003). — Eight plants for each treatment were further grown in continuous light in order to establish flower formation. Vegetative growing and flower formation of plants were evaluated on the sixth week after the treatment.

Results

UV-absorption and ^{32}P-activity can be measured in the ranges of s-RNA and r-RNA. Two peaks of r-RNA are likely corresponding to the 18S and 28S RNA, (cf. OOTA and UMEMURA 1970). At DNA only UV-absorption can be measured; in the course of incubation period, no ^{32}P-labelling occurred.

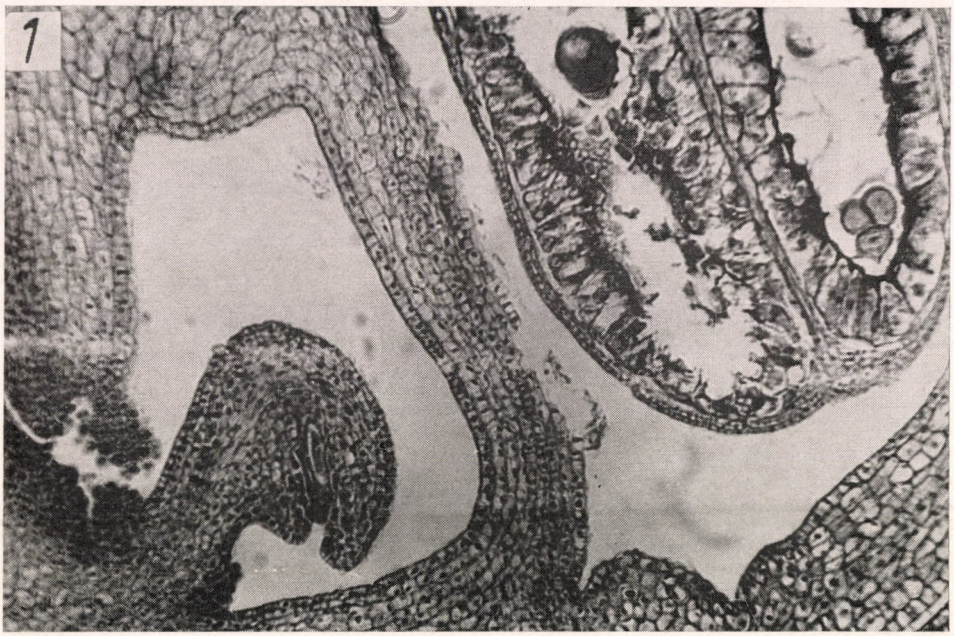
The most remarkable observation the comparison of data between treated and untreated plants (Figs 1 and 2) is that RNA synthesis of treated plants is strongly suppressed. As another difference, the course of curves for s-RNAs is dissimilar in one Figure from the other. Moreover, the maximum ^{32}P-activity appears behind r-RNA (in fractions 70 to 80) for treated plants being even lower in absolute values than for untreated plants.

Definite injury was observed in cotyledons of further grown plants, three of them actually died. It can be seen from the data in Table 1 that the reduction in flower formation cannot be separated from the inhibition of the

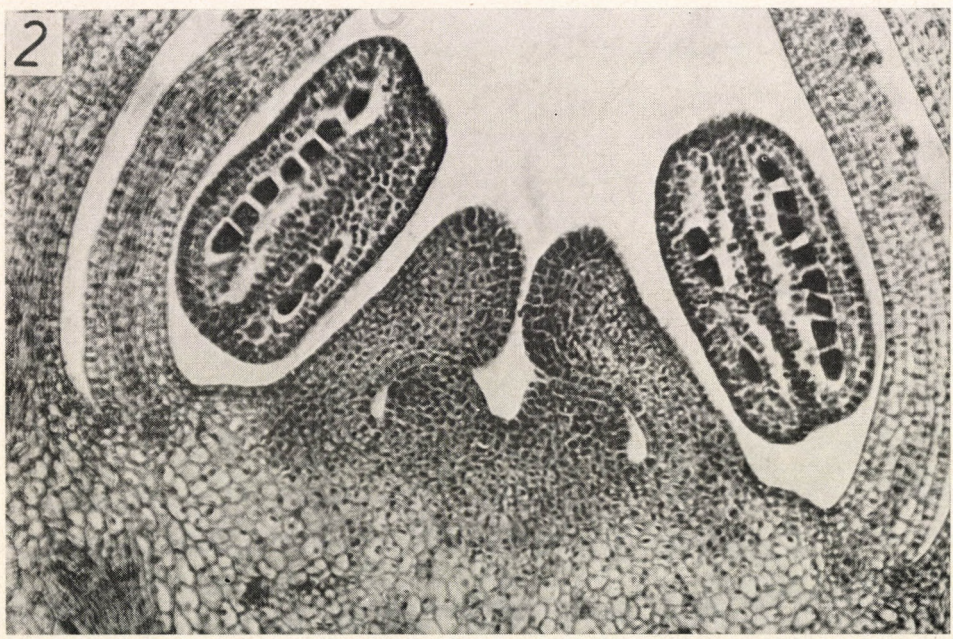
Table 1

Vegetative growth and flower formation of plants with or without bromacil treatment

Treatment	Total number of internodes per plants	Length of internodes (mm) on the average of		Number of flowerbuds per plants			Number of lateral flowers per total of internodes
		all internodes	the 1st and 2nd basal internodes	total pieces per plant	number of terminal flowers	number of lateral flowers	
Bromacil	3.6	2.9	2.8	4.8	3.0	1.8	0.5
Untreated	5.0	24.4	14.5	6.9	2.9	4.0	0.8



Picture 1. Section of an anthera of a lateral flower bud of untreated plant, on the sixth week after flower induction



Picture 2. Longitudinal section two of antherae of a lateral flower bud of a plant treated with bromacil. Prepared on the sixth week after flower induction

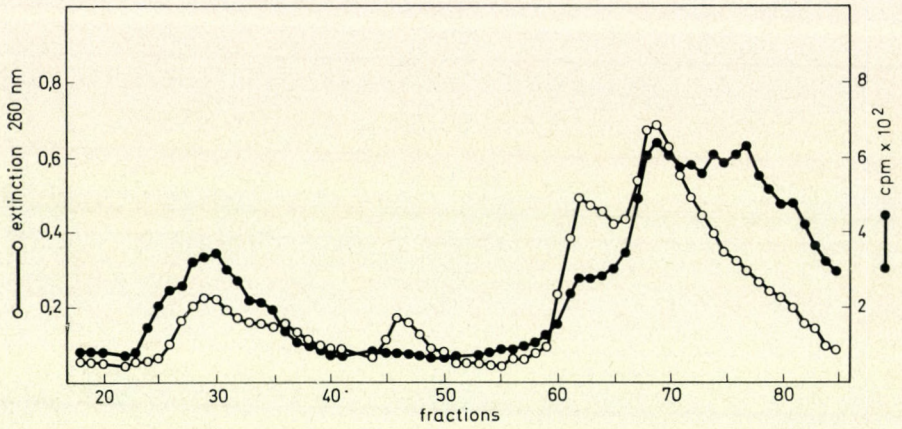


Fig. 1. UV-absorbancies and ^{32}P-radioactivities of nucleic acids separated by a MAK column for untretaed plants

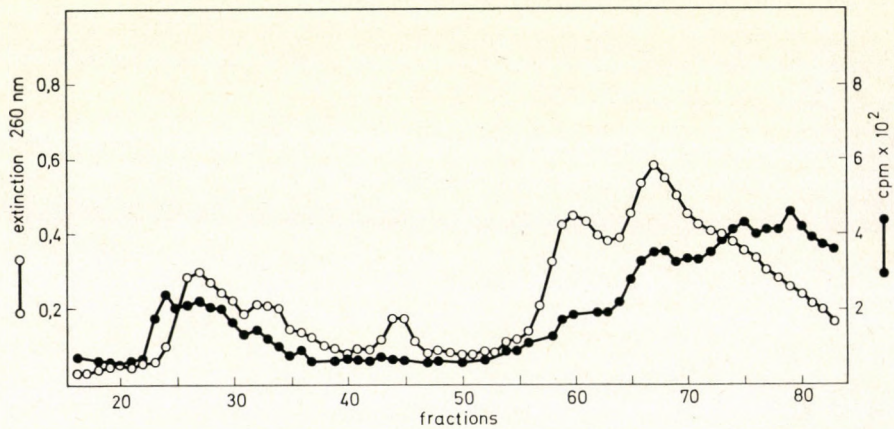


Fig. 2. UV-absorbancies and ^{32}P-radioactivities of nucleic acids separated by a MAK column after treatment with bromacil

vegetative growth. Only a single index (i.e. pieces of lateral flowers over the total number of internodes) suggests that inhibition of flower formation is higher.

Development of the parts of flowers is also inhibited as shown in Pictures 1 and 2 where section are presented from antherae of lateral flowers grown in the same position.

Discussion

It was first reported by YOSHIDA et al. (1967) then by OOTA and UMEMURA (1970) that in *Pharbitis nil* a new reproductive m-RNA is formed by the effect of induction. A corresponding peak, however, in the range behind r-RNAs could not be indentified in our experiments. In our investigation (even by authors mentioned above) the pulse labelling was carried out immediately after dark period. It is reasonable, since the same compound (bromacil) effectively inhibited the flower formation of XANTHIUM during the translocation, too (COLLINS et al. 1963). Moreover the 5-fluorouracil and 5-fluorodeoxyuridine in treatments of *Pharbitis* seedlings reduced the number of flower bud per plant, applied until 24—40. hours after beginning of dark period (ZEEVAART 1962).

A strong inhibition was found in the synthesis of s-RNA and r-RNA. It is in agreement with the result that isocyl, which is practically identical with bromacil, inhibits markedly the incorporation of uracil-2-^{14}C into RNA in Sinapis arvensis (POZSÁR 1972). Only few data are available about utilization of bromacil for the above subject. It inhibits the flower formation of a short-day plant, *Xanthium pennsylvanicum* Wall., but injury of leaves has also been reported (COLLINS et al. 1963). According to GOREN et al. (1969), however, it stimulates the flower formation in *Citrus sinensis*. Results from our previous treatments of apple trees (BUBÁN 1969) involved inhibiting effects in flower bud formation when applied repeatedly at lower concentrations than phytotoxical ones. Treatments were only partly sensitive to their timing. A single treatment with high (phytotoxical) concentrations was much less effective. These observations made specificity of bromacil doubtful and led to the decision of the above investigations. Since inhibition of the vegetative development of trees could not be noticed, the effect of bromacil might be considered selective — solely in practical respects of fruit-growing. According to the indices for its mode of action, described in the present paper, however, only a non-specific general depressive effect can be considered.

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АКТИВНОСТЬ ОКСИДАЗЫ ГЛИКОЛЕВОЙ КИСЛОТЫ И СОДЕРЖАНИЕ ХЛОРОФИЛЛА В ЛИСТЬЯХ КУКУРУЗЫ

Л. ДЕЖИ

БИОЛОГИЧЕСКАЯ СТАНЦИЯ БУДАПЕШТСКОГО УНИВЕРСИТЕТА, АЛЬШОГЁД

(Пришого 2—ого марта 1974 года)

Changes in chlorophyl content and in glycolic acid oxidase activity during the vegetation period were examined on the basal and apical parts of the leaves of Martonvásár-602-maize grown in field conditions. Chlorophyl content was found to be smaller in the basal parts of the leaves than in the apical tissues. However, during the interval of the vegetative period when investigations were carried out there occurred no substantial difference and change in the chlorophyl contents of the lower and upper levels of the leaves. As against this, the activity of glycolic acid oxidase was higher in the basal tissues of the leaves, that is, in the relatively younger ones with a lower chlorophyl content. The activity of the examined enzyme in the leaves of the lower level of maize was smaller in both the basal and apical parts than in those of the leaves of the upper levels.

In the early phase of the vegetation period (7th July), at the time of stem formation, the activity of the glycolic acid oxidase was 5—8 times higher than at the time of wax ripening (31st August). The activity of the glycolic acid oxidase in the leaves developed during the flowering formation was of similar value to those occurring in the leaves formed at the early phase of development. After pollination, the activity of glycolic acid oxidase rapidly decreased, shown also in the enzyme activity of leaves developed at a later phase of the vegetative period. On the basis of our data it can be inferred that in maize the rate of glycolic acid oxidase activity during the period following flowering is determined by not so much the physiological age of the individual leaves as that of the plant itself.

Введение

Гликолевая кислота — один из ранних продуктов фотосинтеза (Benson and Calvin 1950), играющая важную роль в процессе обмена веществ. Из гликолевой кислоты может иметь место образование щавелевой кислоты, глицина, серина, фосфоглицериновой кислоты и других соединений (Richardson and Tolbert 1961, Pritchard et al., 1962, Tolbert and Cohan 1953, Tolbert 1963, Schou et al., 1950. Гликолевая кислота принимает участие в образовании белков, углеводов, циклических соединений (Колесников, 1962а). Гликолатно-глиоксалатная система находится в тесной связи с процессами фотофосфорилирования (Edward et al., 1969, Omata and Tsukamoto 1970). В превращении гликолевой кислоты в глиоксалевую кислоту принимает участие оксидаза гликолевой кислоты. Этот энзим, обычно в больших количествах находится в зелёных частях растения, в листьях (Clagett et al., 1949, Колесников 1948а, 1948б), и связан с хлоропластами (Колесников и сотр. 1970).

В процессе старения листьев, механического повреждения или заболеваний, начинается распад хлорофилло-белкового комплекса, что проявляется в пожелтении листьев. Этот процесс сопровождается спадением активности оксидазы гликолевой кислоты (Farkas 1963). Если срезанные листья поместить в 10^{-2} М раствор кинетина, то содержание хлорофилла, а также активность оксидазы гликолевой кислоты некоторое время сохраняется на уровне нормы (Dézsi and Farkas 1964). Активность оксидазы гликолевой кислоты, а также синтез хлорофилла повышается в том случае, если освещать этилированные листья (Колесников и Еменова 1956, Kuczmak and Tolbert 1962, Tolbert and Burris 1950). На основании вышеприведённых данных можно предположить, что имеет место тесная связь между содержанием хлорофилла и активностью оксидазы гликолевой кислоты.

Опыты, описанные выше имели место с листьями растений выращенных в искуственных условиях, или в оранжереях. Было интересно проверить, имеет ли место подобная зависимость в растениях, выраженных в природных условиях, и на более длительном отрезке вегетационного периода. С этой целью в процессе развития кукурузы исследовалась активность оксидазы гликолевой кислоты и содержание хлорофилла.

В результате предыдуших исследований было установлено, что в процессе вегетационного периода имеет место необычно высокое содержание K и Ca в основаниях и верхушках листьев (Dézsi, Frenyó 1967). Содержание K было выше в основаниях, а Ca в верхушках листьев. Различие в содержании K и Ca определённо объясняется неодинаковостью процессов обмена в разных частях листа. Исходя из этих предположений в данной работе исследуется содержание хлорофилла и активность оксидазы гликолевой кислоты, отдельно — в основаниях и в верхушках листьев.

Материал и методика

Исследовалась кукуруза М. 602, выращенная в свободном грунте. Кукуруза была посеяна 4. V. Пробы и их анализ имели место 7. VII., когда растение имело 5 листьев. Так как нижние два листа обычно слабо развиты (быстро желтеют и засыхают), нижний уровень отсчитывался с третьего листа. В процессе вегетационного периода пробы брались 5 раз, в различные периоды развития кукурузы. Для анализов использовались навески в 1 г., которые брались с шести растений одинакового роста с одинаковым количеством листьев. Пробы растирались в 3 мл. 7,8 pH фосфатном буфере. После гомогенизации, объём вытяжек доводился до 10 мл. Содержание хлорофилла определялось по Арнону (1949), активность оксидазы гликолевой кислоты (по количеству синтетизированной глиоксалевой кислоты), колориметрическим методом Колесникова (1962б).

Результаты и дискуссия

В таблице № 1 представлены результаты анализов проб, взятых с листьев за два различных периода времени.

Из таблицы видно, что, хотя содержание хлорофилла обычно ниже в

тканях основания листьев, чем токовое в тканях верхушки, резких различий в содержании хлорофилла на этих уровнях не наблюдается.

Активность оксидазы гликолевой кислоты в основании листьев т. е. в сравнительно более молодой ткани, обычно выше, чем в верхушечных тканях листа. Установлено также, что активность энзима в листьях нижнего яруса (как у основания, так и в верхушечной части листа) обычно ниже, чем таковая в листьях верхнего яруса. Исходя из данных таблицы № 1, а также из результатов, полученных в процессе исследований в более поздний период, очевидно, что начиная от 6 листового уровня вверх, активность оксидазы гликолевой кислоты, намного выше таковой, чем активность в листьях нижнего яруса. В таблице № 2 дана сводка проведённых анализов, и средние величины по 5 нижним листьям и по листьям верхнего яруса. Необходимо отметить, что цветение начинается у 6. листа и с этой точки зрения данные таблицы № 2 представляют также определённый интерес.

Результаты по содержанию хлорофилла, приведённые в таблице № 2 сходны с результатами, данными в таблице № 1, т. е. количество хлорофилла обычно меньше в тканях основания, по сравнению с тканями верхушки. Сравнение средних величин по 5 нижним листьям с данными верхнего уровня показывает, что резких отличий здесь не обнаружено. На основании полу-

Таблица 1

Содержание хлорофилла и оксидазы гликолевой кислоты в тканях различных участков листьев

Время взятия проб	Уровни листа, считая снизу	Содержание хлорофилла в мг/г свежей ткани		Активность оксидазы гликолевой кислоты мг/г свежей ткани/час	
		В основании листа	В верхушке листа	В основании листа	В верхушке листа
VII. 20	1	2,08	4,34	2,28	2,56
	2	3,60	4,05	3,96	2,88
	3	3,91	4,20	5,04	2,94
	4	3,91	2,95	5,76	3,24
	5	3,91	4,63	5,76	3,36
	6	3,91	4,63	7,20	4,44
	7	3,48	4,34	5,88	4,32
	8	3,60	4,20	7,02	3,96
	9	3,47	4,20	5,16	4,56
VIII. 4	1	3,25	4,05	1,80	1,44
	2	3,50	4,92	2,52	1,38
	3	3,88	4,92	2,76	1,38
	4	4,63	4,63	2,94	1,50
	5	4,78	4,92	2,94	1,56
	6	4,78	4,92	3,30	2,10
	7	4,05	4,63	3,60	2,04
	8	3,71	4,63	3,72	2,76
	9	3,91	4,63	3,54	3,12
	10	3,91	4,63	3,48	3,30
	11	4,05	4,63	3,54	4,20

Таблица 2

Содержание хлорофилла и активность оксидазы гликолевой кислоты в нижних и верхних уровнях листьев

Время взятия проб.	Содержание хлорофилла в мг/г свежей ткани				Активность оксидазы гликолевой кислоты мг/г свежей ткани/час			
	Средние величины 5 нижних листьев		Средние величины верхних листьев		Средние величины 5 нижних листьев		Средние величины верхних листьев	
	Основание	Верхушка	Основание	Верхушка	Основание	Верхушка	Основание	Верхушка
VII. 7	3,03	4,10			6,29	5,47		
VII. 20	3,48	4,03	3,61	4,34	4,56	3,00	6,31	4,32
VIII. 4	4,01	4,69	4,07	4,63	2,60	1,45	3,56	2,92
VIII. 16	3,83	4,38	4,04	4,41	0,90	0,57	1,26	0,75
VIII. 31	3,66	3,82	4,14	4,13	0,80	0,73	1,33	0,62

ченных результатов можно придти к выводу, что в процессе вегетационного периода содержание хлорофилла не изменяется.

Большие различия имеют место в активности оксидазы гликолевой кислоты. Во первых очевидно, что в процессе вегетационного периода, в период образования стебля (VII. 7), активность оксидазы гликолевой кислоты в 5—8 раз больше таковой, чем в период восковой спелости (VIII. 31). Известно, что активность оксидазы гликолевой кислоты спадает параллельно со старением листьев (Farkas 1968). Необходимо отметить, что у кукурузы листья верхнего уровня образуются сравнительно поздно, т. е. являются относительно молодыми, и тем не менее содержание энзима в них довольно низкое. Это вытекает из данных таблицы № 1, откуда ясно видно, что VII. 20. активность энзима была намного выше (на всех листовых ярусах), чем через 2 недели — VIII. 4. Несмотря на то, что за этот период времени развились листья самого верхнего яруса (10—11 уровень), которые были самыми молодыми, тем не менее активность энзима в основании этих листьев сходна с таковой листьев 6—9 яруса, т. е. листьев намного старше по возрасту. В более ранний период развития растений, за такой же отрезок времени, во вновь образовавшихся листьях такого спада не наблюдалось. Так VII. 7, т. е. в период 5 листьев, активность энзима в основаниях листьев была — 6,29 мг/г свежего веса/час, а через 2 недели VII. 20, в основании вновь образовавшихся листьев верхнего яруса, активность энзима — 6,31. Таким образом можно предположить, что величина активности оксидазы гликолевой кислоты у кукурузы в более поздний период развития растений определяется не столько возрастом листьев, сколько физиологическим периодом развития самого растения.

Необходимо отметитъ, что VII. 20. началось цветение кукурузы, а значит можно утверждать, что в этот период, величина активности энзима в развитых листьях сходна с таковой в более ранее образовавшихся листьях. После

опыления активность оксидазы гликолевой кислоты резко спадает, и этот спад наблюдается и в листьях образовавшихся в более поздний период.

Исходя из данных таблицы № 1 и № 2, (сравнивая активность энзима у основания и верхушки листьев), становится ясно, что эта активность, в противоположность содержанию хлорофилла, всегда выше у основания листа.

На основании полученных данных автор приходит к выводу, что тесная связь между содержанием хлорофилла и активностью оксидазы гликолевой кислоты имеет место только во всходах, особенно в случае повреждения растений (тогда начинается распад хлорофилла в листьях, сопровождающийся снижением активности энзима), или в случае освещения этилированных листьев, что ведёт к повышению синтеза хлорофилла и росту активности оксидазы гликолевой кислоты.

Необходимо отметить, что даже во всходах не всегда имеет место корреляция между содержанием хлорофилла и активностью энзима. В наших предыдущих исследованиях (Дежи, Фаркаш, 1969), было показано, что в проростках ячменя, которые обрабатывались аденином, аденозином или бензимидазолом, активность энзима остаётся неизменной, тогда как содержание хлорофилла спадает.

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STUDIES ON INTERSPECIFIC ASSOCIATION PROCESSES IN SPACE

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Changes depending on the sample unit size of the interspecific associations were studied by the aid of PCA (incl. Varimax rotation), in the 12 most frequent or dominant undergrowth species of a xerothermophylous oak stand.

Interspecific association of pairs of species, with the use partly of the Bravais—correlation coefficient (procedure A), and partly of a specifically modified correlation coefficient (procedure B) were examined.

A complete PCA was carried out in each of the 4 (increasing) block sizes with both of the procedures. Now for the first time the results (the situation of the variables in the factor space) are illustrated in the form of a dendrogram, with the help of an agglomerative method of cluster analysis.

The results of procedure A show that the interspecific associations — although a great deal of similarities also appear with the contiguous block sizes — rearrange in a considerably degree when the block size is increased.

With procedure B the above mentioned rearrangement is even more substantial. Results imply that the effect of ecological factors on the interspecific associations is also "scale sensitive", and manifests itself "step-wise", so it is a function of sample size too.

The importance of examining the association processes in space (and in general the "spatial processes") as the prerequisite of further analyses is concurrently emphasized.

I. Introduction

I.1. "The effect of sampling size on indications of association has been largely overlooked . . ." wrote GREIG-SMITH (1964, p. 105) a decade ago. Unfortunately, his statement is still valid.

It is still very little what we know about association processes in space, that is, changes in interspecific and interlocal association depending on the sampling unit size (JUHÁSZ-NAGY—DÉVAI—HORVÁTH 1973).

Although numerous theoretical and practical works testify that the associations are "sensitive" to the sampling unit size (GOODALL 1952, GREIG-SMITH 1964, KERSHAW 1961, 1964, JUHÁSZ-NAGY 1967a, b, 1973, NOY-MEIR—TADMOR—ORSHAN 1970, etc.) it still seems as if this would in most cases be forgotten — especially when multivariate methods (PCA, FA, Canonical correlation, Cluster-analysis, etc.) are applied — and only one, fixed quadrate size (chosen in general without preexaminations, haphazardly) is used at the sampling. By the time the discussion of the results it is not even mentioned

what effect of such type of error committed in this way may have on the results.

I.2. To the questions outlined above attaches, partly, the recently developed method called multiple pattern analysis (WALKER—NOY-MEIR—ANDERSON—MOORE 1972) with the help of which variability related to vegetation sampling units of various sizes (block sizes) can be examined separately.

This, however, leads from examinations of a "purely" structural character to the examinations of an ecological (causal) character where the analysis of the vegetation variability is actually only a means to help the endeavour to make inferences on the "underlying" ecological factor-complexes.

However, the ecological factors (and also groups of factors) are "scale-sensitive", therefore, they again cannot be examined (either by themselves, or through their effects) on the basis of only one sampling unit size.

I.3. For studying this phenomenon, after GREIG-SMITH (1952) and THOMPSON (1958), we used the ANOVA technique — extended to species pairs — in order to be able to separate the effect of the factor complexes on the vegetation occurring on the various scales (with various block sizes).

At the same time we also examined how the block sizes ever increasing with the successive contractions, influence the interspecific associations analysed with the "traditional" technique.

I.4. Thus the subject of our study was that outlined in I.1 and I.2 above. In accordance with this, the analysis runs on two parallel lines — starting from the same basic data. As for the results, they were evaluated by "going through one line" on the one hand, and by making comparisons between the results "at points with identical height" (results belonging to identical block sizes), on the other.

I.5. The study by FEKETE—SZUJKÓ-LACZA (1973) is built on the same basic material. It examines the variation in number and sign of significant interspecific correlations, in dependence on the sampling unit size.

II. Material and method

II.1. The basis of the examinations was offered by the vegetation data of the sample plot in the Remete Mountain of the Buda Mountains, near Budapest (for the description of the sample plot see PRÉCSÉNYI—FEKETE—SZUJKÓ-LACZA 1967, SZUJKÓ-LACZA—FEKETE 1971).

As a point of departure, the basic data are taken from the estimated cover values (expressed in percentages) of the 12 most frequent or dominant species in the undergrowth of the calciphilous xerothermophylous submediterranean oak wood. These 12 species in order of sequence are: 1. *Vicia sparsiflora*, 2. *Lithospermum purpureo-coeruleum*, 3. *Oryzopsis virescens*, 4. *Dictamnus albus*, 5. *Geum urbanum*, 6. *Lathyrus niger*, 7. *Polygonatum latifolium*, 8. *Melittis grandiflora*, 9. *Brachypodium pinnatum*, 10. *Polygonatum odoratum*, 11. *Lapsana commmunis*, 12. *Dactylis glomerata*. The migration of 7 of these 12 species is promoted by their vegetative shoot system, in various ways and to very different extent. The various growth forms have influence upon the pattern as well (PRÉCSÉNYI—FEKETE—SZUJKÓ-LACZA l. c.). The vigour of growth in the shoot systems (individuals), and its intensity has an important part in the competition (FEKETE—SZUJKÓ-LACZA 1973).

II.2. Sampling was carried out by using a grid of quadrates in a sample plot of 1024 m², where the basic sampling unit (BL 1) was 2×2 m; the number of replications is thus 256 (cf. THOMPSON 1958). By adding up two contiguous basic quadrate, BL 2 was produced (by joining units perpendicular to the gradient direction of the slope); then by adding up two BL 2 (parallelepipedal) sampling units of slope direction, the BL 4 quadrate, and finally from two of BL 4 quadrates, the BL 8 parallelepipeds were produced. In this way four blocks of varying size were obtained, the surface of each being twice as large as that of the preceding one. The same calculations were carried out on the data of all four block sizes.

II.3. As has been mentioned (I.4.) the analysis and the calculations following from them — with each of the block sizes — ran the course of two parallel lines (hereinafter marked with A and B).

II.3.1. In the case of A, the ISC matrix of the 12 species was constructed from the Bravais product—moment correlation coefficients ($\mathbf{R}_A$) according to the recognized technique.

II.3.2. In the case of B, (cf. I.3.), the possibilities provided by the analysis of variance were used and its technique followed (GREIG-SMITH 1952, THOMPSON 1958).

II.3.3. It can justifiably be assumed that each sample plot is heterogeneous so that the various heterogeneities appear on various scales. For pedological, but in general: physical heterogeneities (and, if they are effective, ecological factors, for the variability of some characteristic, for example mass values of the species prone to their influence) studied in spot pieces of determined dimension, factors appearing in greater dimensions than the one selected are also responsible. Their effect has been separated in the cases of the various species in the following way: from the total value of variance of the smaller block size concerned, the value of variance between groups of the subsequent block size was extracted; the remainder variance obtained in this way was always considered as characteristic of the smaller block size concerned. In such a way it has become possible to examine — at each block size separately — the effect of the ecological heterogeneity of the sample plot (occurring on various scales) on the associations of the 12 species.

II.3.4. In the correlation coefficients calculated in the recognized way (II.3.1), the resultant of the effects, separated according to the above described method, is reflected. The ecological factors appearing on the scale of all the other larger block sizes may take part in the forming of the variability of the vegetation in the case of each block size.

II.3.5. On dealing with the details of the calculative procedure (II.3.2., II.3.3), the variance of the species (percentage of coverage) has been calculated after THOMPSON (l. c.).

The correlation coefficient between the two species (r') has been calculated, in the course of procedure B, concerning BL 1, in the following way:

$$r' = \frac{\mathrm{cov}'\,(a_1, b_1)}{[\mathrm{var}\,(a_1) \cdot \mathrm{var}\,(b_1)]^{1/2}}, \text{ in general}$$

$$r' = \frac{\mathrm{cov}'\,(a_j, b_j)}{[\mathrm{var}\,(a_j) \cdot \mathrm{var}\,(b_j)]^{1/2}}, \text{ where}$$

$$\mathrm{cov}'\,(a_j, b_j) = \frac{\dfrac{\Sigma x_j y_j}{l} - \dfrac{\Sigma x_{j+1} y_{j+1}}{l+1}}{\dfrac{N_k}{l+1}}$$

(cf. WALKER—NOY-MEIR—ANDERSON—MOORE 1972); the number of blocks here is $i = 1, 2, \ldots,$ $(, j + 1, \ldots$ the number of quadrates in the block $k = 1, 2, \ldots, l, l + 1 \ldots N_k$ is the number of all quadrates; x and y are the cover percentage of species a and b.

Thus the ISC values here are produced not on the basis of existing mass conditions, but in a corrected way. The second type of correlation matrix $\mathbf{R}_B$ has been constructed of them.

II.4. Then, starting from the $\mathbf{R}_A$ and $\mathbf{R}_B$ matrices, the complete procedure of PCA was carried out, including the VARIMAX rotation as well (the calculations were performed on the CDC 3300-type machine of the HAS).

II.5. For the interpretation of one of the most important results (the situation of the variables in factor space) — on the basis of the idea of the second author — the agglomerative method elaborated by ORLOCI (1967) was used for the first time. This cluster-constructing procedure is one of the most wide-spread, most natural method in the ever increasing family of cluster analyses.

II.5.1. The FORTRAN program of the procedure was written by GOLDSTEIN and GRIGAL (1972). This program was made suitable — with modifications — by the second author for running it on CDC 3300 and for connecting it with the PCA program.

Following the usual way of illustration of the results of the cluster analyses, a part of the results of the 8 PCA carried out (the groups of the variables — in the present case of the species) assumes an illustrative form in the 8 dendrograms.

II.5.2. In our opinion, this part of the PCA result can be interpreted much more effectively in this way than is done the world over even today: by taking into consideration only the first 3—4 factors, and by the series of the two, or the most, the three dimensional projections of this factor space of 3—4 dimensions.

On the other hand, with the procedure followed by us: (1) all the factors can be used in the evaluation; (2) the situation, distance, grouping of the variables in the factor space — related to each other — can be demonstrated in an exact, objective and illustrative way.

Both properties facilitate the evaluation of the results — in the case of the PCA this always belongs in the most difficult tasks.

II.6. However, the other part of the results of PCA (the situation of the variables related to the factor axis) cannot be seen at all from the dendrogram. This is the reason why the carrying out of the VARIMAX rotation was considered necessary. Thus — in a "chemically pure" form, indeed — the interdependences of the variables and the axes were obtained.

III. Results and their discussion

III.1. One of the best characteristics of the effectiveness of the PCA is the course of the cumulative curve of the variance extracted by the factors. It has been depicted with the various block sizes separately each (Figs 1—4).

It can be seen in each diagram that the curve of procedure A lies below that of B. Thus, for example, to obtain at least 80% of the variance, 6—8 factors were needed with procedure A. On the other hand, in the case of procedure B five factors seemed already enough with all four block sizes. Besides, there is a difference also between the various block sizes: the larger the block to which the curve belongs, the steeper the rise of his curve. It can be inferred from this that with the increase of the block size the hyperellipsoid of the variables becomes more and more dense. The same can be said of the difference between procedure A and B (with each block size): with procedure B the distribution of the variables was "clustered" in relation to procedure A.

III.2. The discussion of the PCA results according to II.5 and II.6 will take place in two groups, namely in III.2.1 and III.2.2

III.2.1. The association of the 12 species is best reflected by their situation in the factor space, which is demonstrated according to II.5, in the form of a dendrogram of each, with both procedures and with all block sizes (Figs 5—12).

III.2.1.1. It is immediately conspicuous with the four dendrograms of the first procedure (Figs 5—8) that more or less similar configurations belong to contiguous block sizes. Several pairs of species keep their close association (topological "closeness") when passing to the following block size.

In a comparison between the analyses of BL 1 and Bl 2, a common feature is the closeness of the species pairs of *Vicia-Polygonatum latifolium*

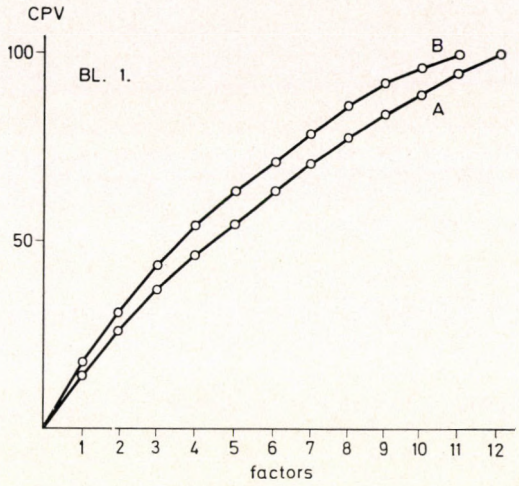


Fig 1

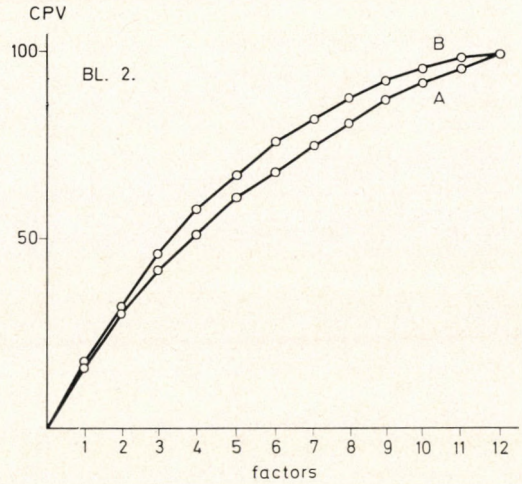


Fig 2

and *Dictamnus-Brachypodium pinnatum*; with BL 2 and BL 4 that of the *Geum-Lapsana* species pair. The *Vicia-Polygonatum latifolium* species pair stands "nearest to each other" with the four block sizes throughout. Along with them, there are several other features indicating continuity, which are "inherited" from the smaller into the larger block sizes. The *Geum-Lapsana-Oryzopsis* species triumvirate forms one group of constellations slightly differing from one another, with all four block sizes, similarly, the *Dictamnus-Brachypodium pinnatum-Polygonatum odoratum* species triumvirate, again with all four block sizes; with BL 1 still along with the *Vicia-Polygonatum latifolium* species pair, while with BL 2 it is already disgrouped of them.

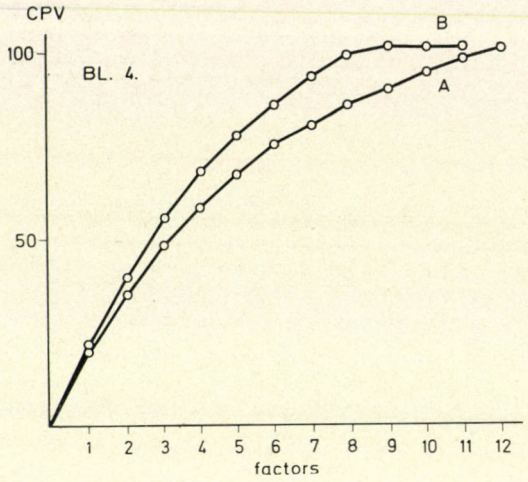


Fig 3

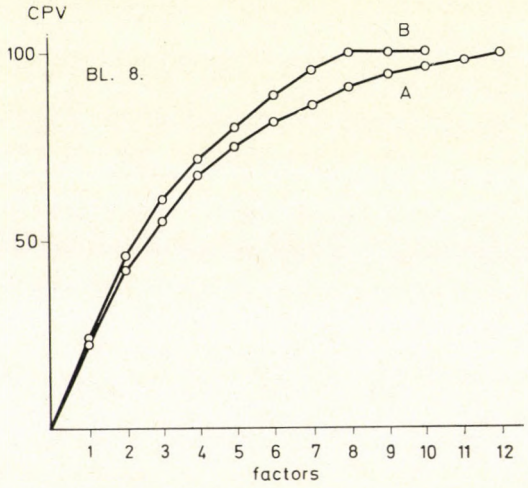


Fig 4

Figs 1—4. Cumulative percentage variance (CPV) extracted by factors at the various block sizes, according to the two kinds of procedure (A, B)

The distribution of the variables into 3 large groups takes already place with the BL 2, thus rearranging, which can be considered essential, takes place between BL 1 and BL 2, and subsequently the species set of the groups is identical. With the BL 8 size, in comparison with BL 4, no essential change takes place.

However, on reviewing the dendrograms it can be stated that, along with similarities, considerable differences also appear among the results pertaining to the various block sizes. These differences accumulate during the

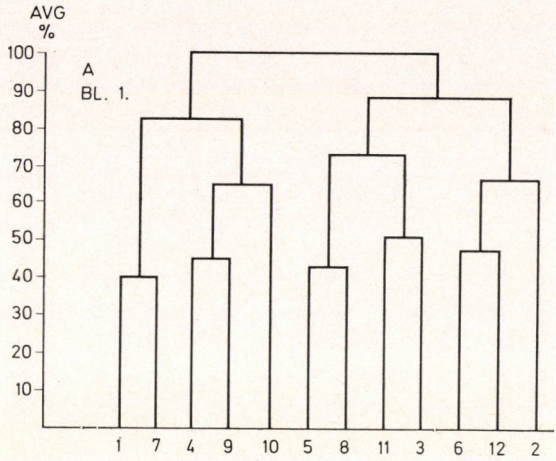


Fig 5

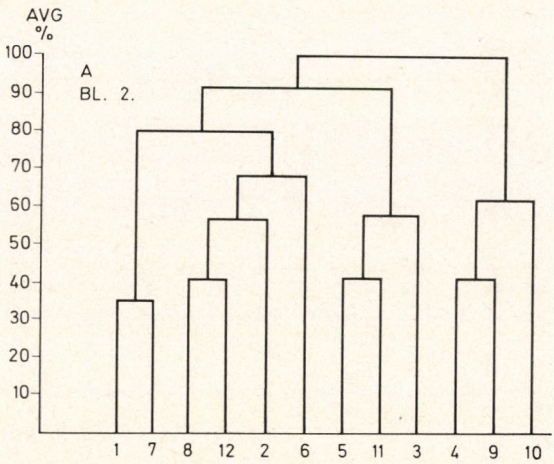


Fig 6

gradual changes, therefore they become fairly considerable among the dendrograms of discontiguous block sizes.

This again calls attention to the fact that interspecific association also depends to a considerable extent on the sampling unit size.

III.2.1.2. When the effects appearing in the scale of the subsequent block sizes — in the case of procedure B — are excluded, there is no pair of species which would keep its close association at two contiguous block sizes. The species belonging to the larger groups also keep changing places (Figs 9—12).

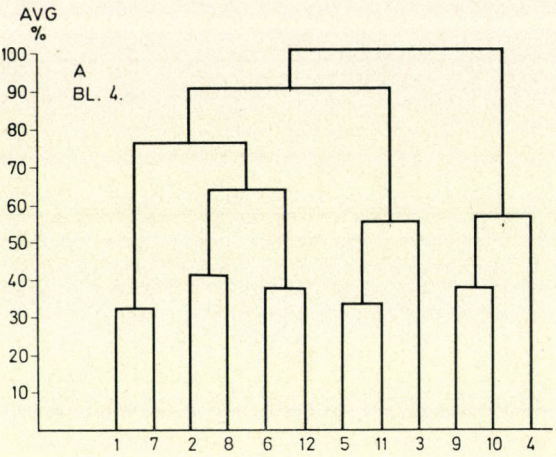


Fig 7

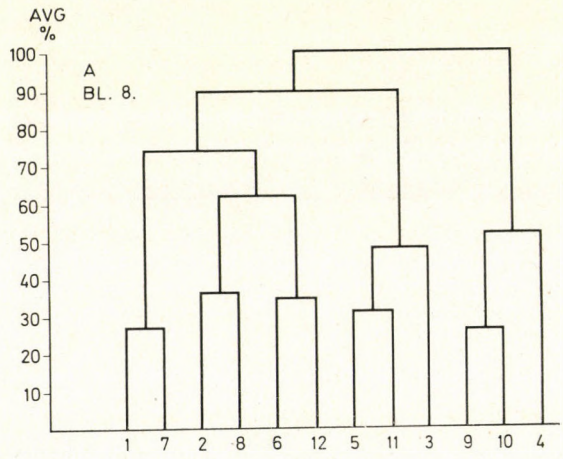


Fig 8

Figs 5—8. Clustering of the species in the various block sizes, on the basis of the result of PCA (procedure A)

III.2.1.3. On considering identical block sizes, the analysis carried out from two matrices ($\mathbf{R}_A$ and $\mathbf{R}_B$) resulted in very different groupings. It is only the *Geum-Melittis* and the *Dictamnus-Polygonatum odoratum* species pairs with BL 1 that keep their association in both cases; also the *Vicia-Polygonatum latifolium* and *Dictamnus-Brachypodium pinnatum* species pair with BL 2. as well as the *Geum Lapsana* species pair with BL 4. No such species pair occurs any more by the time we arrive at BL 8.

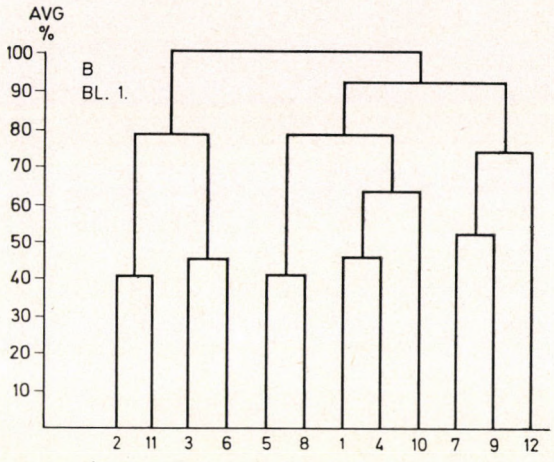


Fig 9

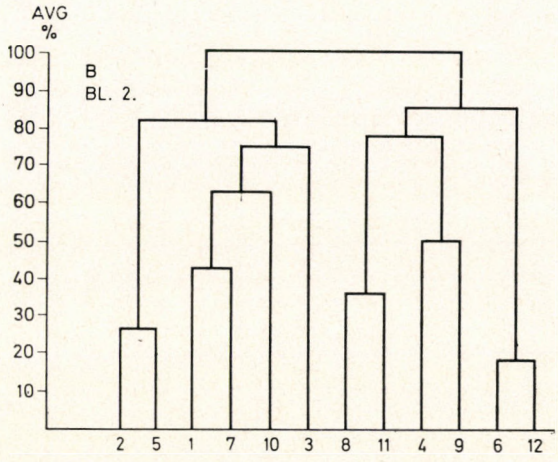


Fig 10

III.2.1.4. Thus the dendrograms obtained with procedure B do not resemble either each other or the ones obtained with procedure A — from identical block sizes.

It can be inferred from this that on the sample plot there indeed exist such actually effective, ecological factors (factor complexes) that excert their effect on the associations of the 12 species in a scale corresponding to BL 2, BL 4, or BL 8 (or just the BL 16) block sizes.

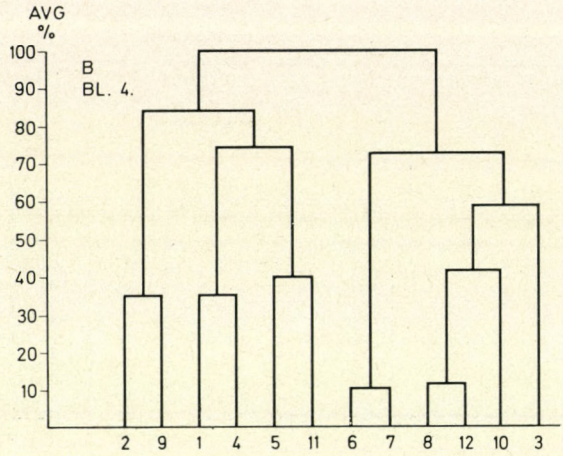


Fig 11

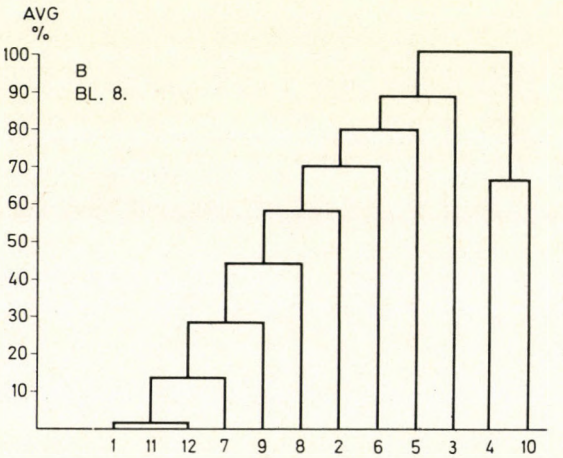
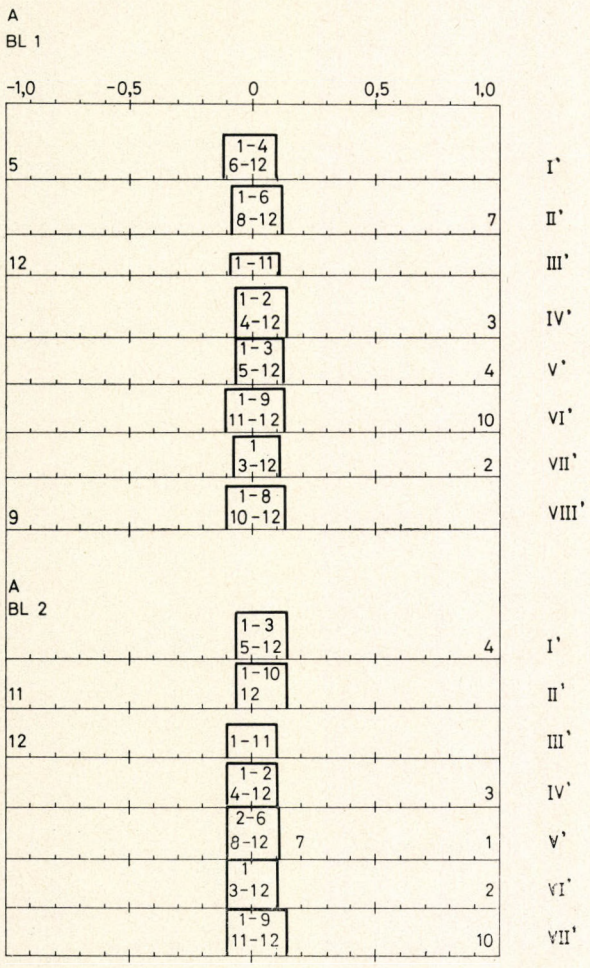


Fig 12

Figs 9—12. Clustering of the species with the various block sizes, on the basis of the result of PCA (procedure B)

III.2.1.5. In our opinion, the statement that the ecological factors are also "scale-sensitive" (cf. I.2) has also been confirmed by this (at least on considering the object examined).

III.2.1.6. On the other hand, the 5 species pairs enumerated in III.2.1.3 are exceptions from the statements made in III.2.1.4: the associations of these are not considerably influenced by the ecological factors appearing on the scale of the subsequent block size concerned.



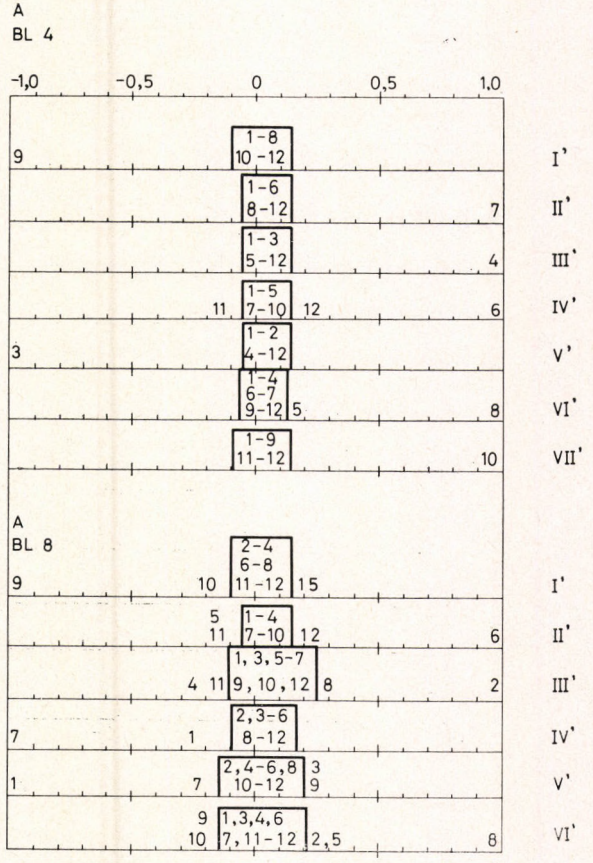


Table I

Position of the species on the axes, according to the various block sizes (procedure A). The loadings of the variables enclosed are abot zero value

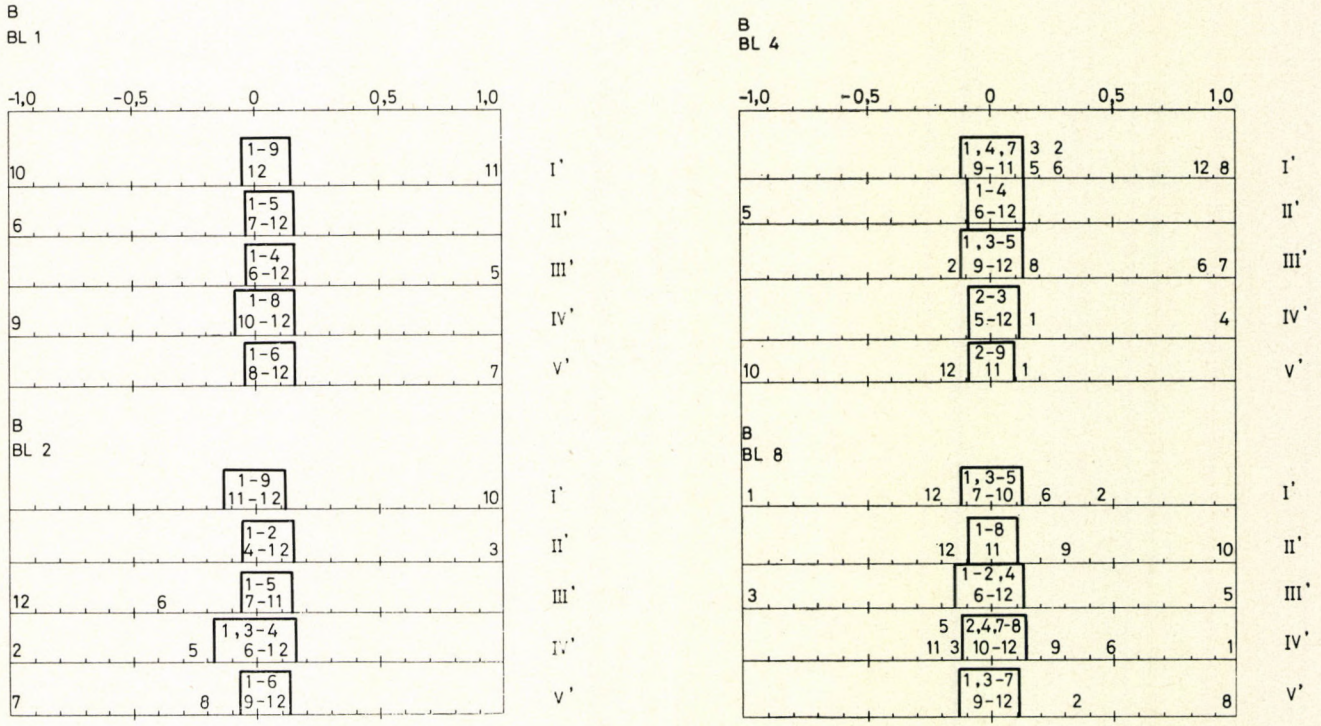


Table II

Position of the species on the axes, according to the various block sizes (procedure B). The loadings of the variables enclosed are about zero value

What have been said in the foregoing sections confirm that different environmental factors are the very effective ecological factors for each of the species, species pairs and species groups. The same factor (-group) may disrupt the association of one pair of species, while it leaves the association of the other one uneffected (and from the point of view of the interspecific association therefore cannot be considered as an ecological factor for the latter). In connection with this question we refer to the work of JUHÁSZ-NAGY, who made a detailed study of the problems outlined above (JUHÁSZ-NAGY 1970).

III.2.1.7. The similarity of the dendrograms of the contiguous block sizes of procedure A is probably caused by the fact that, in the data of the smaller block size concerned, the environmental variability appearing on the scale of the larger block size concerned has already also originally manifested itself.

III.2.2. In accordance with what has been said in II.6, the other part of the PCA results is illustrated in Tables I—II. where the main axes are plotted up to 80% extracted variance. It can be seen with both procedures that while with smaller block sizes the species in general cluster around the 0 point, with larger block sizes some of them draw away on to the positive or negative axis section.

On considering contiguous block sizes, with procedure A, several similarities can be discovered. For example *Dactylis* lies both with BL 1 and BL 2 block sizes at the end of the axis III, while *Oryzopsis* at the end of axis IV; at the same time, *Dictamnus* lies already at the end of the first instead of the fifth axis; at the sixth and seventh axes *Polygonatum odoratum* and *Lithospermum* merely change places. A feature indicating some similarity in the common factor spaces of BL 4 and BL 8 is that the first axis is a "*Brachypodium* axis", while on the other hand the sixth factor exerts the greatest influence upon *Melittis*; these two species even keep their situation related to each other.

With procedure A, no factor as would have a considerable influence with all four block sized was found.

According to procedure B, in the above interpretation, similarity appeared only between BL 1 and BL 2: with both sizes, factor I has the greatest influence on *Polygonatum odoratum*, while factor V on *Polygonatum latifolium*. If the number of common species having great (≥ 0.9) loading is considered as the measure of similarity, then in contrast with procedure A it can be said that there is no greater similarity between two contiguous block sizes than between any two non-contiguous block sizes.

In the case of procedure B, the *Polygonatum odoratum* lies at the end of (any) factor axis with all four block sizes, thus one such common factor can be found at each scale that effects *Polygonatum odoratum*.

IV. Conclusions

IV.1. The results given in detail in III.2.1.1 confirm the fact — mostly disregarded when planning concrete examinations — that the interspecific associations depend to a considerable degree on the sampling unit size. Therefore the examinations of such character should not be limited to one single quadrate size. What is more, the more thoroughgoing exploration extending to the more kinds of objects of how the associations depend on the quadrate size would be desirable. In other words, the thorough examination of association processes in space is needed (cf. JUHÁSZ-NAGY—DÉVAI—HORVÁTH 1973).

IV.2. Similar statements are valid as regards the effect of ecological factors on the interspecific associations (cf. III.2.1.5), namely, in connection with procedure B as well.

IV.3. The method which we name procedure B (II.3.2) was considered suitable for examining on the one hand whether — in the case of the object examined — there are such ecological factors (complexes) as are effective in a scale larger than the one at issue; on the other hand, it can also be examined in this way how the interspecific associations modify when the effects appearing on the "larger scale" — if there are such — are calculatively excluded.

ACKNOWLEDGEMENT

For the approval of our using the basic data originally processed in co-operation for pattern analysis, our thanks are due to Mrs. J. SZUJKÓ-LACZA and to Mr. I. PRÉCSÉNYI. To the latter also for putting forward the suggestion of factor analysis of interspecific correlations varying according to increasing block sizes.

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NACHWEIS DER BASTARDE VON ORCHIS CORIOPHORA × O. LAXIFLORA LAM. SSP. PALUSTRIS UND O. CORIOPHORA × ANACAMPTIS PYRAMIDALIS BEI DABAS

Von

O. GEILING und G. SCHULTZE

JENA U. NEUSTADT/ORLA

(Eingegangen am 25, Mai 1973)

The author describes the *Orchis Coriophora*, which is a large group. All friends of orchid are interested in it.

Die in fast allen europäischen Ländern im Zurückgehen begriffene *Orchis coriophora* dürfte auch dort, wo sie nicht zu den ausgesprochenen Seltenheiten zählt, beim Auftreten in grösseren Gruppen jeden Orchideenfreund interessieren.

Ein solches grösseres Vorkommen fanden die Verfasser bei einer Exkursion durch Ungarn am 28.05.1972 in der Nähe von Dabas vor. Der Standort — ein ausgedehntes Wiesengelände auf humosem bis teilweise anmoorigem Sand — ist ungarischen Botanikern als in seiner Artenzusammensetzung interessant und vielseitig bekannt, (doch überraschte das Auftreten von *Orchis coriophora* selbst unseren ungarischen Begleiter, der den Standort in den zurückliegenden Jahren des öfteren besucht hatte). Das Vorkommen umfasste insgesamt etwa 780 blühende Pflanzen, die in der Nähe eines inmitten der Wiesen gelegenen Erlenbruches standen. Es handelte sich dabei um mehrere räumlich etwas voneinander getrennte Fundstellen mit zwei deutlichen Konzentrationspunkten, an denen etwa 450 bzw. 200 und 120 Exemplare auf engstem Taum gezählt wurden (vgl. Abb. 1).

Ohne damit die Begleitflora erschöpfend wiederzugeben, seien nachstehend die wichtigsten Arten genannt:

Koeleria javorkae
Dactylis glomerata
Briza media
Festuca rubra
Anacamptis pyramidalis
Rhinanthus angustifolius ssp. *grandiflorus*
Ononis spinosa
Lotus corniculatus
Tetragonolobus maritimus
Genista tinctoria
Salvia pratensis
Polygala vulgaris
Leontodon hispidus
Plantago lanceolata
Plantago media
Achillea millefolium (rosablühend)

Abb. 1. Dichter Bestand von *Orchis coriophora* L.; in der Bildmitte *Anacamptis pyramidalis* (L.) Rich.

An einigen Fundstellen in etwas grösserer räumlicher Entfernung auch *Orchis laxiflora* Lam. ssp. *palustris* (Jacq.) A. et G.*, *Campanula sibirica*, *Verbascum phoeniceum*, *Linum austriacum* und an feuchten Stellen, so z. B. an einigen Wassergräben, *Iris sibirica* und *Iris spuria*. Bei den eigentlichen Fundstellen handelte es sich durchweg um etwas trockenere, erhöhte Stellen in einem sonst frischen bis feuchten Wiesengelände auf humosem bis teilweise anmoorigem Sand.

Selbst bei Berücksichtigung der Vielzahl verschiedener Orchideenarten am Fundort und deren allgemein bekannten Bastardierungsneigung war das Auffinden der Bastarde von *Orchis coriophora* × *O. laxiflora* ssp. *palustris* und *O. coriophora* × *Anacamptis pyramidalis* eine echte Überraschung. Zwar wurde der Bastard *Orchis coriophora* × *O. laxiflora* ssp. *palustris* bereits bei Sári und Kiskörös nachgewiesen (vgl. Borsos, 1962), doch stellt der intergenerische Bastard *O. coriophora* × *Anacamptis pyramidalis* für Ungarn einen Neufund dar (Soó 1973).

* Die im ungarischen Sprachgebrauch der von Soó eingeführten Kollektivart *Orchis laxiflora* Lam. zugeordnete Subspecies *palustris* (Jacq.) A. et G. (vgl. auch Schäfer, 1971 und Borsos, 1972) wird in der deutschsprachigen Literatur als selbständige Art *Orchis palustris* Jacq. ausgewiesen.

Übersicht über die prioritätsberechtigten Bezeichnungen der bisher bekannten Kombinationen von *Orchis coriophora* L. × *Orchis laxiflora* Lam. einschliesslich ihrer Unterarten bzw. *O. coriophora* × *Anacamptis pyramidalis* (L.) Rich.

	Orchis coriophora L.
Orchis laxiflora Lam.	
ssp. *palustris* (Jacq.) A. et G.	*O.* × *timbalii* VELEN. 1882
„ *laxiflora*	*O.* × *parvifolia* CHAUB. 1821
„ *elegans* (Heuff.) Soó	O. × *reinhardii* UGRINSKY ex CAM.
Anacamptis pyramidalis (L.) Rich.	× *Anacamptorchis ticiensis* GSELL 1948

Darüber hinaus ist der Bastard *Orchis coriophora* ssp. *fragrans* (Poll.) Cam. × *Anacamptis pyramidalis* (L.) Rich. unter der Bezeichnung × *Anacamptorchis simorrensis* Cam. Berg. Cam. Europe 95 1908 (KELLER—Soó 1932) bekannt geworden. EBERLE (1965) konnte schliesslich auch den Bastard *Orchis laxiflora* ssp. *laxiflora* × *Orchis fragrans* nachweisen.

Die von den Verfassern in Ungarn vorgefundenen Bastarde seien im folgenden beschrieben.

Abb. 2. und *3. Orchis coriophora* L. × *Orchis laxiflora* Lam. ssp. *palustris* (Jacq.) A. et G.

1. Orchis coriophora L. × **Orchis laxiflora** Lam. ssp. **palustris** (Jacq.) A. et G.

2 Exemplare in 1/ca. 80 bzw. 25/15 m Entfernung zum jeweils am nächsten stehenden Expl. der beteiligten Elternart. (Die Bastarde selbst waren etwa 2000 m voneinander entfernt.) Pflanzenhöhe: 35 bzw. 24 cm. Stengel leicht bogig aufsteigend. Blätter 5 bzw. 4; 9—5 cm lang, 12—6 mm breit zugespitzt lanzettlich, auch die oberen Blätter stengelumfassend. Brakteen grünlich, nicht überlaufen. Blütenähre locker, 10 bzw. 8 cm lang. Zahl der Einzelblüten: 18 bzw. 13. Blüte: Lippe und Sporn dunkelviolett, Perigonblätter braunviolett, innen leicht braunstreifig; Lippe 6 mm lang, dreilappig, gezähnelt, alle Zipfel gleichbreit, Seitenlappen nicht zurückgeschlagen, sondern die gesamte untere Lippenhälfte nach hinten gebogen wie bei *O. coriophora*, an der Lippenbasis karminrote Sprenkelung auf aufgehelltem Grund; Perigonblätter des inneren und äusseren Kreises zu einem Helm verwachsen, Spitzen der Sepala frei endend, doch überwiegend einander anliegend; Sporn 10 mm lang, stumpf hornförmig, abwärtsneigend, zu zwei Drittel so lang wie der Fruchtknoten.

Der Gesamthabitus der Pflanze ähnelt einer etwas kleinen, ungewöhnlich dunklen *Orchis laxiflora* (vgl. Abb. 4).

Abb. 4. Der Bastard *Orchis coriophora* L. × *O. laxiflora* Lam. ssp. *palustris* (Jacq.) A. et G. neben einer *O. laxiflora* (links; zur besseren Demonstration versetzt)

Abb. 5. und 6. Gattungsbastard *Orchis coriophora* L. × *Anacamptis pyramidalis* (L.) Rich.

2. Orchis coriophora L. × **Anacamptis pyramidalis** (L.) Rich.

1 Exemplar in 0,5/2,5 m Entfernung zum jeweils am nächsten stehenden Exemplar der beteiligten Elternarten. Pflanzenhöhe: 23 cm. Stengel dünn, gerade. Blätter 4; 7—2 cm lang, 7—2 mm breit, schmal-lanzettlich, gleichmässig über den Stengel verteilt. Brakteen so lang wie der Fruchtknoten, violett überlaufen. Blütenähre kopfig, aufgelockert, 2,5 cm lang. Zahl der Einzelblüten 15. Blüte rot bis rotviolett, Perigonblätter etwas dunkler als die Lippe; Lippe 5 mm lang, zurückgebogen, tief dreiteilig mit verlängertem Mittelzipfel, dieser schmaler als die aussen gezähnelten, leicht braunstreifigen Seitenzipfel, Lippe mit dunkler Punktierung bzw. Fleckung, am Grunde mit deutlich sichtbaren Höckerchen; Perigonblätter insgesamt zusammenneigend, zugespitzt und teilweise miteinander verklebt, Knospen dadurch auffallend geschnäbelt; Sepala auch bei den geöffneten Blüten zusammenneigend, doch in drei freie Spitzen auslaufend; Sporn etwas kürzer als der Fruchtknoten.

Erstaunlicherweise wurde das eingangs beschriebene Areal mit seinen reichen Orchideenvorkommen bisher nicht unter Schutz gestellt. Die Wiesenflächen werden extensiv genutzt und offensichtlich nur gelegentlich durch

Rinder überweidet. Fehlende Weidezäune und die Weitläufigkeit des Geländes lassen Trittschäden grösseren Ausmasses in nächster Zukunft kaum erwarten. Die Zusammensetzung des Pflanzenbestandes und die helle Färbung der sehr locker stehenden und im allgemeinen niedrigwüchsigen Gräser lassen erkennen, dass Mineraldünger, insbesondere Stickstoff, bisher nicht eingesetzt wurde — ein Tatbestand, der das Fortbestehen des Artenreichtums auf diesen Wiesen zunächst garantiert. Neben den bereits genannten Orchideenarten wurden auch *Ophrys scolopax* Cav. ssp. *cornuta*, *Ophrys insectifera*, *Gymnadenia conopsea*, *Dactylorhiza incarnata* in rot- und weissblühenden Formen sowie *Orchis purpurea* (abgeblüht) vorgefunden. Nach Angaben von MILKOVITS (1972) kommen aber auch *Ophrys sphegodes* var. *fucifera* und *Orchis ustulata* sowie weissblühende Formen von *Orchis laxiflora* ssp. *palustris* vor.

*

Bildnachweis: Abb. 1 bis 6 — Reproduktionen nach Color-Diapositiven der Verfasser.

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A COMPARISON BETWEEN THE ALGAFLORAE OF TWO FISHPONDS

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The algaflorae of two fishponds with different trophity and identical saprobity were compared from qualitative and quantitative viewpoints.

In the fertilized lake with higher trophity, the average individual/liter values of the algae surpassed by 4.2 times those of the unfertilized lake. A great majority of the larger standing crop consisted of green algae. It is a very characteristic phenomenon that in summer in the more eutrophic lake a *Chlorophyta* species arrives at a saliently high dominance, while the species number of the population remains the same, or it increases only slightly.

Parallel with an increase in industrialization, the eutrophication of the natural waters in Hungary also increases (FELFÖLDY-TÓTH 1970). In order to attain familiarity with the qualitative and quantitative characteristics of this expectable primary production in the natural conditions of our country we must well ahead to investigate, communities as for example that of a fishpond which are amply supplied with nutrient elements. In our county, HORTOBÁGYI (1950, 1957, 1958, 1959, 1963, 1965, 1967) carried out investigations into algae of fishponds; UHERKOVICH and KÁRPÁTI (1965) published their results of investigations into the algae of lake waters enriched with mineral nutrient elements, but no paper has been published so far in our country on the algae of fish ponds complex utilization (goose, noble carp, grass carp, carp fish).

Near Gödöllő, in the area of the farm of Babat, on the stream Aranyos, which is of low water supply, eleven fishponds were made up by dam. These are filled with water mainly at spring time when the snow is thawing; further water supply, and as a consequence overflowing of the lakes into the one down below, is not considerable. One fertilized lake (Fishpond No. 8, counting upwards from below) algologically was compared with the only unfertilized. On the shore of Fishpond No 8, on the average 2000 geese are bred in concrete folds yearly. The manure which cannot be gathered with shovel is water-jetted into the fishpond. Preceding the sampling, in October, the geese were turned out to Fishpond No. 10, too. This extra charge in fertilizer sharply manifested itself in the algaflorae. The ponds are 2.0—2.5 m deep at their deepest place; their surface is around 2 hectares.

Owing to the irrational fish-planting (as for example the introduction of 500 pieces of two-summer grass carp into Pond No. 8 which does not possess macroflora), no correlation could be detected between the algal number and fish production. In both of the ponds, three species of fish lived, viz.: carp (*Cyprinus carpio* m. *nobilis*), carp fish (*Hypophthalmichthys molitrix*), and grass carp (*Ctenopharyngodon idella*).

Water-chemical data on the fertilized lake:

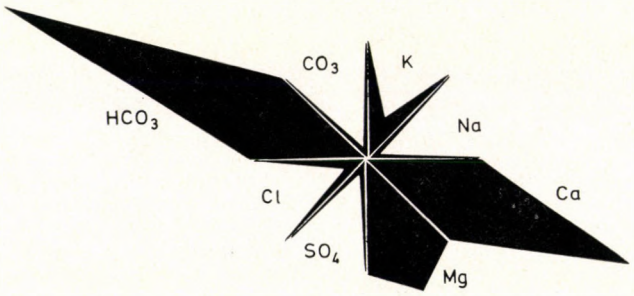
Solved O_2: 12.3 mg/l, saturation 104%
Free CO_2: 0.00
Oxygen consumption $KMnO_4$: 19.9; $K_2Cr_2O_4$: 45.5 mg/l
pH: 8.10; conductibility: 653×10^{-6} Ohm/cm
m alkalinity: 7.0 W°
total solved material: 416 mg/l
total dry material: 475 mg/l
total hardness 19.6 NK°, CO_3-hardness: 19.6

nitrogen total: 3.98 mg/l organic

NH_4-N: 0.70 mg/l ... 0.66 mg/l N
NO_2-N: 0.05 mg/l ... 0.01 mg/l N
NO_3-N: 1.25 mg/l ... 0.28 mg/l N

The methods of collecting and processing

In 1969, samples were taken from the two fishponds mentioned, on January 8, February 13 (29 chemical water sample in February), March 13, April 15, May 12, July 24, August 25, September 30, October 28. The water



sample taken at the damp, the deepest part of the pond, was treated with IKI acetate mixture, then with a few drops of formalin, and counted in the 1 ml chambers of a planktonmicroscope. In accordance with UTERMÖHL's recommendation (1958), I counted an identical quantity of the organisms of

various frequency, that is 50—100 pieces each, and, on the basis of the chamber volume belonging to this quantity, I calculated the specific number per liter of the various algae.

An aliquot part of my samples was filtered through membrane filter by J. OLÁH, who determined in this way the total number of bacteria in the water.

The saprobiological analysis, which — owing to organic fertilization — has an extraordinary importance, was carried out on the basis of the equation by PANTLE and BUCK, by averaging the saprobic values given in column *s* of the Enclosure No. 1. (FELFÖLDY 1972). In the calculation, however, I did not use the prescribed *h* scale of merely six grades for frequency, but, accordingly, the dominance values (D%) of my Table.

Results

During the qualitative examinations, I determined 191 species of 95 genus, 33 variety, and 11 forms. Both fishponds were rich in taxa; the members of the *Chlorophyta* Phylum participated with remarkably many species.

A genus the most abundant in species is *Scenedesmus*.

Table I

The number of taxa found in the two fishponds

	Fertilized only	Common	Non-fertilized only
Cyanophyta	15	9	4
Euglenophyta	15	11	5
Chrysophyta	11	18	15
Pyrrophyta	—	4	—
Chlorophyta	28	63	24
Total	69	105	48

Quantitative results are given in Enclosure No 1; 22 species marked with asterisk proved to be new data (HORTOBÁGYI 1972) in relation to the flora of Hungary. The individuum/liter values of the algae are on an average 4.2 times greater in the fertilized lake than in the non-fertilized one. The composition of species is advantageous (HORTOBÁGYI 1958): the proportion of the green algae is on the average above 50%, which rises sometimes even above 90% in summer. Along with the well-known *Chlorophyta* dominance (HÖHNE—KLOSE 1966), the most characteristic phenomenon of the eutrophic surround-

ings of the fertilized lake in summer is that a saliently large population comes into existence from one or two green algae species. After a longer or shorter time, the so-called leader species is replaced by another similar species. This phenomena is well observable in the October phytoplankton of the non-fertilized lake. Before sampling, irregularly, this lake had also been given fertilizer charge. In comparison with the preceding month, the number of individuals in the algae doubled. *Mycacanthococcus cellaris* has a share nearly half of the total number of individuals. At this phase saprobity is not higher than the average, thus the organic matter mineralized rapidly. The existence of the leader species with high dominance seems to be in connection with trophity also here.

At the time of high dominance values in various green algae species, impoverishment of the species spectrum is not observed, on the contrary, the number of species occasionally increases, to a small extent.

No linear correlation was found among the quantitative data of the various algae Phyla.

The correlation of bacteria and algae is contradictory in the two lakes: there is an inversed ratio in the fertilized lake, and a direct proportion in the non-fertilized lake between the two groups.

Investigation into saprobity showed identical, relatively little (2.0—2.1, that is beta-mesosaprob) contamination in the two lakes.

The fact that the water of the fertilized lake is dark green indicates that a large part of the algae quantity raised by fertilization is not able to build into the next lambda level (carp fish, zooplankton), thus it is useless for man, loses.

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Key to the signs. The saprobionta value of the various algae is given in column "s" of Enclosure No. 1; column "A" indicates whether the particular alga lived only in the fertilized lake (T), or only in the unfertilized lake (L); in the column of the various months "i" shows the 1000 individual/liter values of the algae, while "D" shows their percentage dominance.

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Fertilized fishponds

	s	A	January	February	March	April	May	July
			i—D	i—D	i—D	i—D	i—D	i—D
1. *Achroonema macromeres** Skuja		T	+					
2. *Anabaena circinalis* Rabh.	1.5	T						+
3. *Anabaena flos-aquae* (Lyngb.)Bréb.	1.5	T						+
4. *Aphanizomenon issatschenkoi* (Ussacz.) Proschkina—Lavrenko	1.5							186—0.05
5. *Chroococcus turgidus* (Kg.) Naeg.	1.5							+
6. *Gomphosphaeria lacustris* Chod.	1.5	T						
7. *Lyngbya circumcreta* G. S. West								
8. *L. epiphytica* Hieron.		T			16—0.21			
9. *L. limnetica* Lemm.			41—1.14					1 674—0.48
10. *Merismopedia marssonii* Lemm.	2.5	T						2 232—0.63
11. *Merismopedia tenuissima* Lemm.	2.5							
12. *Microcystis aeruginosa* Kütz.	2.5	T						+
13. *M. elachista* f. *planctonica* G. M. Smith		L						
14. *M. flos-aquae* (Wittr.) Kirchn.	1.5	T						+
15. *M. marginata* (Menegh.) Kütz.	1.5	L						
16. *Oscillatoria limnetica* Lemm.	1	L						
17. *O. pseudogeminata* G. Schmid								186—0.05
18. *O. tenuis* var. *tergestina* Rabenh.	3.5	T						
19. *Pelonema subtilissima** Skuja								
20. *Phormidium foveolarum* (Montagne) Gomont.	3	L						
21. *P. mucicola* Naum. et Huber—Pest.		T	+					+
22. *Pseudanabaena articulata* Skuja						186—0.64	1 674—4.12	
23. *P. catenata* Lauterb.	2.5		369—10.26					
24. *Rhabdoderma lineare* var. *spirale* Wolosz.	2	T						
25. *Romeria leopoliensis* (Racib.) Koczw.		T						
26. *Spirulina laxa* Smith		T		82—2.62	164—2.16			+
27. *Synechocystis aquatilis* Sauv.		T	1 763—49.01					
28. Unknown *Cyanophyta*		T						2 046—0.59
Cyanophyta total			2 173—60.41	82—2.62	180—2.37	186—0.64	1 674—4.12	6 324—1.80
29. *Euglena acus* Ehrb.	2.5			8—0.27				
30. *E. acus* var. *longissima* Defl.	2.5	T						
31. *E. antefossa* L. P. Johnson?		T						
32. *E. oxyuris* f. *minima* Bourr.	2	T						+
33. *E. pisciformis* Klebs.	2.5							8—0.00
34. *E. polymorpha* Dang.	2	T						
35. *E. spathirynchа* Skuja		L						
36. *E. tripteris* (Duj.) Klebs	2.5							372—0.12
37. *E. viridis* Ehr.	3	T					93—0.23	
38. *Euglena* sp.				41—1.31				41—0.01
39. *Lepocinclis cymbiformis** *Playf.*		T						
40. *L. ovum* var. *conica* Allorge et Lef.	2.5	T						186—0.05
41. *Phacus acuminatus* Stokes	2.5	T						
42. *P. caudatus* Hübn.	2			2—0.06				
43. *P. caudatus* var. *minor* Drez.		L						
44. *P. curvicauda* Swir.	1.5	L						
45. *P. granum* Drez.		T						
46. *P. helicoides* Pochm.	2	T	+					
47. *P. longicauda* (Ehr.) Duj.	2.5							186—0.05
48. *P. orbicularis* Hübn.	2.5	L						
49. *P. pseudonordstedtii* Pochm.		T		+				
50. *P. pyrum* (Ehr.) Stein	2					186—0.64		
51. *Trachelomonas dybowskii* Drez.		T						
52. *T. planctonica* Swir.	2						372—0.91	186—0.05
53. *T. planctonica* var. *vermiculosa* Balech.			20—0.56					
54. *T. scabra* Playf.								
55. *T. similis* Stokes		T						
56. *T. verrucosa* var. *granulosa* (Playf.) Conr.		L						
57. *T. volvocina* Ehr.	1.5			123—3.93		558—1.92		
58. *T. volvocinopsis* Swir.		T					744—1.84	
59. *Trachelomonas* sp.		T						
Euglenophyta total			20—0.56	174—5.57		744—2.56	1 209—2.98	979—0.28
60. *Amphora ovalis* Kütz.	1	T						
61. *Anomoeoneis sphaerophora* (Kütz.) Pfitz.		L						
62. *Attheya zachariasi* J. Brun	1	L						
63. *Bicoeca cristallina** Skuja					82—1.08			
64. *B. ovata** Lemm.		T				3 348—11.53		
65. *B. planctonica* Kissel	2	L						
66. *Centritractus africanus* Fritsch et Rich								
67. *C. brunneus* Fott		T						
68. *Cercobodo varians** Skuja		L						
69. *Chrysococcus guttaeformis* Hortob.		L						
70. *Cocconeis placentula* var. *euglypta* (Ehr.) Cl.	1	L						
71. *Cyclotella chaetoceras* Lemm.		T				17 112—59.00		
72. *Desmatractum indutum* (Geitl.) Pasch.		T					372—0.91	
73. *Dinobryon divergens* Imhof	1.5							21—0.00
74. *Fragilaria crotonensis* Kitt.	1	L						
75. *Gloeobotrys coenococcoides** Fott							930—2.29	
76. *Goniochloris mutica* (A. Braun) Fott								372—0.10
77. *G. sculpta* Geitl.	1	L						
78. *Gyrosigma attenuatum* (Kütz.) Rabenh.	2	L						
79. *Kephyrion littorale** Lund					287—3.78	1 488—5.12	1 302—3.20	
80. *Khawkinea acutecaudata** Skuja		L						
81. *Mallomonas acaroides* Perty	2				264—3.24			
82. *Mastigella* sp.								
83. *Melosira granulata* (Ehr.) Ralfs	1		12—0.33	82—2.62	2—0.02			
84. *M. granulata* var. *angustissima* Müll.	1.5							930—0.29
85. *M. granulata* var. *angustissima* f. *spiralis* Hust.	1.5	L						
86. *Monas vorax** Skuja		T						
87. *Monosiga ovata* S. Kent							1 116—2.75	
88. *Multicilia lacustris* Lauterb.	3.5	T						186—0.05
89. *Navicula hungarica* var. *capitata* (Ehr.) (Ehr.) Cl.	2.5	L						
90. *Nitzschia acicularis* W. Smith	2.5			41—1.31	14—0.18	558—1.92	2 046—5.04	
91. *N. palea* (Kütz.) W. Smith	3	L						
92. *Ophyocytium capitatum* Wolle	1	L						
93. *O. cochleare* A. Braun	1	L						
94. *Paraphysomonas vestita** (Stokes) De Saedeleer								186—0.05
95. *Pseudokephyrion entzii* Conrad	1	T					+	
96. *Rhizosolenia longiseta* Zach.	1	T						41—0.01
97. *Salpingoeca amphoridium* J. Clarc		T						
98. *Stephanodiscus hantzschii* Grun.	2.5						3 720—9.18	
99. *Synedra acus* Kütz.	2			328—10.50		2 604—8.97	1 116—2.75	
100. *S. ulna* (Nitzsch.)	2	T			4—0.04			
101. *Synura petersenii** Korschik .	2				2 624—34.61			
102. Unknown epiphyte								
103. Other *Centrales*				287—9.18			930—2.29	
104. Other *Pennales*					744—2.56			
Chrysophyta total			12—0.33	738—23.61	3 259—42.95	25 854—89.10	11 532—28.41	1 736—0.50
105. *Ceratium hirundinella* (O. F. Müll.) Schrank	1.5							
106. *Cryptomonas pusilla* Bachm.								
107. *Cryptomonas* sp.			656—18.24	984—31.49	410—5.40	186—0.64	1 116—2.75	186—0.05
108. *Gymnodinium* sp.			12—0.33			8—0.02	8—0.02	186—0.05
Pyrrophyta total			668—18.57	984—31.49	410—5.40	186—0.64	1 124—2.77	372—0.10

Unfertilized fishpond

August	September	October	January	February	March	April	May	July	August	September	O
i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D
1 488—0.80				2—0.02						744—0.95	70—0.05
				2—0.02							
+											
		744—0.49							+		558—0.44
12 088—6.81		4 650—2.98									
	2 976—0.58									4 278—5.47	
2 418—1.30		558—0.35									
										372—0.47	
								+			
									+		
			8—3.13								930—0.74
2 232—1.21											186—0.15
+					615—11.71		372—0.95	+			930—0.74
			+								
	930—0.19				492—9.38		930—2.38				
+											1 302—1.05
+											
+											
		558—0.35									
18 786—10.12	3 906—0.77	6.510—4.17	8—3.13	4—0.04	1 107—21.09		1 302—3.33			5 394—6.89	3 976—3.17
	9—0.00	15—0.00									70—0.06
+											
+											
558—0.30											
								+			
651—0.35				+		+		12—0.05			
930—0.50			+	8—0.08							
93—0.05	296—0.06										
651—0.35	370—0.07										
+											
186—0.10				+			+	+			
								60—0.24	+		
651—0.35											
								+	+		
									+	+	
	7—0.00	372—0.23							+		
	4 464—0.87										
		1 488—0.97					186—0.47				
744—0.40				8—0.08						+	
	370—0.07										186—0.15
	930—0.18										
									41—0.33		
2 511—1.36				2—0.01		82—1.75		+	123—0.99		2 046—1.63
	4 650—0.93										
6 975—3.76	11 096—2.18	1 875—1.20		18—0.17		82—1.75	186—0.47	72—0.29	164—1.32		2 302—1.84
		84—0.05									
			8—3.13								
							186—8.47				
				8—0.08	8—0.15						
	744—0.14										
								279—1.16	123—0.99		
		12—0.00								186—0.23	
		84—0.05									
							930—2.38				
			2—0.88								
									246—1.98		
	744—0.14										
67—0.03	7—0.00									+	
						328—7.00					
						164—3.50					
558—0.30	2 418—0.47	372—0.23						186—0.77	328—2.64	186—0.23	
						+					
								8—0.03			
		4 836—3.09				328—7.00	1 860—4.76	1 860—7.75	164—1.32	1 860—2.37	
					2—0.03						
					1 558—29.72				186—0.23		
	558—0.11						1 116—2.85				
2 418—1.32							372—0.95				
			16—6.18		22—0.41				451—3.81	+	
								279—1.16	41—0.33		
	1 860—0.36										
	930—0.18									1 302—1.66	
41—0.02											
								+			
	1 116—0.22				328—6.25	287—6.13	1 860—4.76				2 232—1.78
										372—0.47	
							+	93—0.38	41—0.33		
							+	8—0.03			
93—0.05					123—2.34				205—1.65		
8—0.00											
41—0.02											
	28 490—5.62	62 124—39.84				416—8.88				8 556—10.98	17 670—14.13
							1 116—2.85				
					+						
					205—3.90	246—5.25	1 488—3.84		164—1.32	+	
					287—5.46	451—9.67	1 860—4.76		41—0.33		
3 226—1.74	36 867—7.24	68 256—43.73	26—10.19	8—0.08	2 533—48.26	2 220—47.43	10 788—27.62	2 713—11.28	1 804—14.52	12 648—16.17	19 902—15.91
		32—0.02		2—0.01						12—0.01	
	3 348—0.65					328—7.00	744—1.91				
10 416—5.61	3 720—0.73	1 116—0.71	163—63.92	8 556—84.37	246—4.68	164—3.51	372—0.95	465—1.93		186—0.24	
372—0.20				4—0.04			186—0.47				
10 788—5.81	7 068—1.38	1 148—0.37	163—63.92	8 562—84.42	246—4.68	492—10.51	1 302—3.33	465—1.93		198—0.25	

		s	A	January	February	March	April	May	July
				i—D	i—D	i—D	i—D	i—D	i—D
109.	*Actinastrum hantzschii* Lagerh.	1.5						12—0.03	372—0.10
110.	*Ankistrodesmus acicularis* (A. Br. Korschik.	2.5			20—0.64				372—0.10
111.	*A. angustus* Bern.	2		573—15.95	82—2.62	82—1.08	372—1.30	558—1.37	7.626—2.18
112.	*A. bibraianus* (Reinsch.) Korschik.	2							
113.	*A. convolutus* Corda		L						
114.	*A. falcatus* (Corda) Ralfs	2.5	T						
115.	*A. longissimus* Lemm.	1.5	T						+
116.	*A. pseudomirabilis* Korschik.			8—0.22					
117.	*A. subcapitatus* Korschik.								
118.	*Carteria multifilis* (Fres.) Dill.	4	T			205—2.70			
119.	*C. peterhofiensis* Kissel.	2	T						279 000—79.82
120.	*Chlamydomonas epiphytica** G. M. Smith		T						
121.	*C. globosa* Snow	3		+				2 790—6.87	
122.	*C. rodhei** Skuja					1 558—20.56	372—1.28		
123.	*C. skujae** Pasch.		T		+			5 022—12.37	
124.	*C.* sp.			82—2.27	+	943—12.42		2 418—5.95	
125.	*Chlorella vulgaris* Beyer.	2.5						2 976—7.33	+
126.	*Chlorhormidium flaccidum* (Kütz.) Fott	1				8—0.10			
127.	*Chlorogonium elegans* Playf.		L						
128.	*C. elongatum* Dang. var.	3	T						
129.	*C. tetragamum** Bohl.		T					+	
130.	*Chodatella amphiricha* Lagerh.		L						
131.	*C. balatonica* Scherff.								
132.	*C. ciliata* (Lagerh.) Lemm.	2	L						
133.	*Chodatella* sp.		L						
134.	*Closterium limneticum* var. *tenue* Ruzicka								
135.	*Coelastrum microporum* Naeg.	2.5						372—0.91	
136.	*C. sphaericum* Naeg.	2.5							930—0.29
137.	*Crucigenia quadrata* Morren	2							2 604—0.74
138.	*C. rectangularis* (A. Brau) Gay	2.5							+
139.	*C. tetrapedia* (Kirchn.) W. et W.			41—1.14				93—0.23	3 534—1.01
140.	*Dicellula inrmis* Fott	2			287—9.18				6 510—1.86
141	*Dictyosphaereium ehrenbergianum* Naeg.	2	L						
142.	*D. pulchellum* Wood	2					372—1.28	372—0.91	186—0.05
143.	*Elakatothrix lacustris* Korsch.		T			246—3.24			1 488—0.42
144.	*Franceia tenuispina* Korschik.								372—0.10
145.	*Gloeotaenium loitlesbergianum* Hansg.		L						
146.	*Hyaloraphidium contortum* var. *tenuissimum* Korschik.			+			372—1.28		
147.	*Kirchneriella lunaris* (Kirch.) Moeb.	2			205—6.56				9 672—2.77
148.	*K. obesa* (W. West) Schmidle	2							2 418—0.69
149.	*Koliella longiseta* (Visch.) Hindák						186—0.64	1 116—2.75	
150.	*Lagerheimia genevensis* Chod.	2						186—0.46	
151.	*L. marssonii* Lemm.								
152.	*Lobomonas ampla* var. *okensis* Korschik.	2	T					+	
153.	*Micractinium pusillum* Fres.is	2.5					186—0.64		
154.	*Mycacanthococcus cellaris** Hansg		L						
155.	*Nephrochlamys subsolitaria* (West) Korschik.							12—0.03	2 418—0.69
156.	*Oocystis elliptica* f. *minor* W. West								
157.	*O. lacustris* Chod.	1.5	L						
158.	*O. parva* W. et G. S. West		T					6 324—15.63	
159.	*O. submarina* var. *variabilis** Skuja								
160.	*Pandorina morum* (Müller) Bory	2.5	L						
161.	*Pediastrum boryanum* (Turp.) Menegh.	2.5							
162.	*P. duplex* Meyen.	2.5							186—0.05
163.	*P. simplex* (Meyen.) Lemm.	2	L						
164.	*P. tetras* var. *tetraodon* (Corda) Rabenh.	1,5	T						372—0.10
165.	*Phacotus lenticularis* (E. Stein)	2				574—7.56			+
166.	*Pteromonas angulosa* Lemm.	1.5	T						
167.	*Scenedesmus acuminatus* (Lagerh.) Chod.	2.5			410—13.14	123—1.62	186—0.64	558—1.37	1 116—0.31
168.	*S. acuminatus* f. *tortuosus* (Skuja) Uherkov.	2.5	T						
169.	*S. acutus* Meyen	2.5		8—0.22	61—1.95				
170.	*S. anomalus* (G. M. Smith) Tiff.								744—0.21
171.	*S. anomalus* var. *acaudatus* Hortob.		L						
172.	*S. arcuatus* Lemm.	2	T						+
173.	*S. brevispina* (G. M. Smith) Chod.		T			+			
174.	*S. coartatus* Hortob.		T						
175.	*S. decorus* Hortob. var.		L						
176.	*S. denticulatus* var. *linearis* Hansg.	2	T						
177.	*S. dispar* Bréb.								186—0.05
178.	*S. dispar* f. *spinosus* Hortob.		T						
179.	*S. ecornis* (Ralfs) Chod.	2.5							
180.	*S. ecornis* (Ralfs) Chod. forma		L						
181.	*S. ecornis* var. *disciformis* Chod.	2.5	T						2 046—0.74
182.	*S. granulatus* W. et G. S. West	2.5						558—1.37	
183.	*S. granulatus* f. *elegans* Hortob.		T						
184.	*S. granulatus* f. *disciformis* Hortob.								
185.	*S. intermedius* var. *bicaudatus* Hortob.	2							+
186.	*S. lefevrii* var. *semiserratus* Uherkov.	2							
187.	*S. lefevrii* var. *semiserratus* Uherkov. forma		L						
188.	*S. longispina* var. *capricornus* Skuja								
189.	*S. opoliensis* P. Richt.	2.5							186—0.05
190.	*S. ovalternus* Chod.								2 232—0.63
191.	*S. opoliensis* var. *bicaudatus* Hortob.		T						
192.	*S. protuberans* Fritsch.								
193.	*S. quadricauda* (Turp.) Bréb	2.5			82—2.62				1 860—0.53
194.	*S. quadricauda* var. *longispina* f. *asymmetricus* (Hortob.) Uherkov.								930—0.29
195.	*S. quadricauda* var. *maximus* W. et G. S. West								+
196.	*S. quadricauda* (Turp.) Bréb. varietas		L						
197.	*S. rectus* Hortob. et Németh varietas		T						
198.	*S. semicristatus* Uherkov.								+
199.	*S. soói* var. *symmetro-granulatus* Hortob.		T						372—0.10
200.	*S. soói* Hortob. varietas 1.								
201.	*S. soói* Hortob. varietas 2.								
202.	*S. spinosus* Chod.	1.5							2 604—0.74
203.	*Scenedesmus* sp.							930—2.29	1 860—0.53
204.	*Schroederia spiralis** (Printz) Korschik.								
205.	*Siderocelis minutissima** (Korschik.) Heynig								82—0.20
206.	*S. oblonga* (Naum.) Fott		T						2 976—0.85
207.	*S. ornata* (Fott) Fott								
208.	*Sphaerocystis schroeteri* Chod.	1	T						
209.	*Staurastrum contortum* G. M. Smith		L						
210.	*S. paradoxum* Meyen	2	L						
211.	*S. polymorphum* Bréb.		L						
212.	*Tetraedron caudatum* var. *incisum* Lagerh.	2							558—0.15
213.	*T. incus* var. *torsum* Turn.	2		12—0.33					558—0.15
214.	*T. limneticum* Borge		L						
215.	*T. minimum* (A. Braun) Hansg.	2						8—0.01	744—0.21
216.	*T. minimum* var. *longispinum** Defl.		L						
217.	*T. muticum* (A. Braun) Hansg.		T						+
218.	*T. triangulare* Korschik.		T					+	
219.	*Tetrastrum glabrum* (Roll.) Ahlstr. et Tiff.		L						
220.	*T. pulloideum* Teiling								558—0.15
221.	*T. punctatum* (Schmidle) Ahlstr. et Tiff.							744—1.84	186—0.05
222.	*T. staurogeniaeforme* (Schroed.) Lemm.	2							372—0.10
223.	*T.* sp.								
224.	*Treubaria triappendiculata* Bern.		L						
225.	*T. varia** Tiff. et Ahlstr.		L						
226.	Other *Chlorophyta*								1 860—0.53
	Chlorophyta total			724—20.13	1 147—36.71	3 739—49.28	2 046—7.06	25 049—61.72	340 090—97.32
	Algae total			3 597	3 125	7 588	29 016	40 588	349 501
	Number of Bacteria (Olán's data)			3 973 000	2 455 000	1 471 000	542 000	4 698 000	3 246 000

August	September	October	January	February	March	April	May	July	August	September	October
i—D	i—D	i—D	—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D	i—D
20 832—11.22	1 860—0.36					41—0.87	186—0.47			32—0.04	186—0.15
	6 882—1.35			8—0.08		82—1.75		744—3.09		558—0.71	558—0.44
4 650—2.50	1 674—0.32	26 226—16.80				123—2.62	2 232—5.71			16 554—21.34	744—0.59
	370—0.07	6—0.00								186—0.23	24—0.01
		+							328—2.64		
	2 232—0,43										
186—0.10							+			558—0.71	8—0.00
	111—0.02	558—0.35					186—0.47				
+											
		+			1 271—24.25					2 232—2.85	
				42—0.41	+	246—5.25		6 138—27.02			
		186—0.11					930—2.38				370—0.29
		3 162—2.02		12—0.11			3 720—9.65	4 185—17.40	246—1.98	930—1.18	
+					11—0.20						
								93—0.38			186—0.15
20—0.01	6 324—1.24	186—0.11									
	12—0.00	186—0.11						+		558—0.71	
											186—0.15
248—0.13		+						93—0.38	123—0.99		
372—0.20	558—0.11							558—2.32	82—0.66		
930—0.50		372—0.23				41—0.87		3 534—14.69	1 558—12.21	186—0.23	
		1 860—1.19						465—1.93	451—3.63	372—0.47	12—0.00
372—0.20						41—0.87		93—0.38	82—0.66		
720—2.00	60 822—11.95	5 022—3.21				82—1.75	186—0.47	2 232—9.28	1 968—15.84	5 580—7.13	7 254—5.80
	19 344—3.80	1 860—1.19	8—3.13			164—3.50				2 046—2.61	15 066—12.04
									82—0.66		
		744—0.49					1 116—2.85		41—0.33		
											8—0.00
2232—1.20	1 302—0.25		16—6.27				1 488—3.80				744—0.59
		21 390—13.70				205—5.05	2 418—6.19	837—3.48	123—0.99	11 532—14.74	
1116—3.60	336 846—66.21										7 812—6.24
2232—1.20		186—0.11			80—1.52		2 232—5.71				
	18—0.00	6 138—3.86					2 790—7.14			5 766—7.37	1 116—0.89
20—0.01	1 488—0.29									930—1.18	
	558—0.11	1 488—0.97								930—1.18	370—0.29
											60 320—48.35
							2 232—5.71			5 022—6.42	
+									41—0.33		
							186—0.47		+		
+								8—0.03			
										+	
31—0.01	100—0.01	+				41—0.87		186—0.77	205—1,65	+	
62—0.03	1—0.00	+	2—0.78				+	+		12—0.01	
						+					
							186—0.47				
+											
	558—0.11	744—0.49				82—1.75	558—1.42	279—1.16	41—0.33	+	
104 160—56.21								+			1 116—0.89
		+									
558—0.30							186—0.47	93—0.38	123—0.99	558—0.71	
								+			
		+									
+		558—0.35				82—1.75					186—0.15
	+								41—0.33		
	+								+		
		+									
20—0.01	744—0.14	372—0.23						372—1.54	246—1.98	+	186—0.15
+		112—0.07							164—1.32	+	186—0.15
	558—0.11										
			8—3.13						+		
+		1 302—0.83			186—1.83	82—1.75	1 116—2.85	372—1.54	1 517—10.55	558—0.71	558—0.44
	+	+							123—0.99		+
	370—0.07					164—3.50			164—1.32		
									+		
	+										
372—0.20										372—0.47	
		+									
		+							+		
		+							+		
20—0.01	1 116—0.22	1 116—0.71							123—0.99	558—0.71	
		+	24—9.45						697—5.61	744—0.95	+
	2 418—0.47									186—0.23	
41—0.02							1 116—2.85			20—0.02	
	+										
20—0.01	+	558—0.35					558—1.42		246—1.98		744—0.59
		930—0.74									
									+		
								+	+		
									+		
62—0.03		372—0.23							205—1.65	1 116—1.42	186—0.15
93—0.05	1 674—0.32	744—0.49					+	48—0.19		744—0.95	370—0.29
							+	+			
20—0.01	370—0.07	+						186—0.77			
								+			
		+									
20—0.01		64—0.04				+			82—0.66	186—0.23	
3 348—1.80		+						+	41—0.33		
	1 488—0.29	744—0.49				41—0.87	186—0.47			558—0.71	370—0.29
		558—0.35								372—0.47	
									82—0.66		
									+		
				1 302—12.86		368—7.92					
145 777—78.57	449 798—88.43	78 302—50.17	58—22.76	1 550—15.29	1 362—25.97	1 686—40.31	25 482—65.25	20 795—86.50	10 455—84.16	59 956—76.69	98 866—79.08
185 552	508 735	156 091	255	10 142	5 248	4 680	39 060	24 045	12 423	78 196	125 046
677 000	1 542 000	2 883 000	890 000	1 616 000	556 000	515 000	5 982 000	1 632 000	5 478 000	8 007 000	4 450 000

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UNTERSUCHUNG DER EPIDERMIS VON REBENBLÄTTERN

Von

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FORSCHUNGSINSTITUT FÜR WEINBAU UND KELLERWIRTSCHAFT, BUDAPEST

(Eingegangen am 27. Juli 1973)

The epidermis of *Vitis vinifera* and other *Vitis* species has been investigated on collodiumexcoriates. It has been stated that the numerical ratio of sunken and in level stomata is characteristic of the different varieties. The development of stomata is demonstrated on the excoriates of developing leaves.

Einführung

Die Blattepidermis hat teils wegen ihrer Variabilität, teils weil sie infolge ihrer oberflächlichen Lage verhältnismässig leicht zu untersuchen ist, und endlich weil sie als Bindeglied zwischen Pflanze und ihrer Umgebung auf die Umwelteinflüsse am meisten reagiert, unter den Pflanzenanatomen immer Interesse erregt.

Die eingesenkten Spaltöffnungen der Weinrebe sind bisher nur von ISTVÁNFFI und PÁLINKÁS (1913) und HEGEDÜS (1969) beschrieben worden. Nach den Feststellungen ISTVÁNFFIS und seines Mitarbeiters kommen bei den Sorten M. Lunel, »Génuai zamatos« (Tschausch), Alicante, Rosaki rouge, Kadarka, Lämmerschwanz, usw. eingesenkte Stomate häufig vor. HEGEDÜS erachtete die grösstenteils eingesenkten Stomata als charakteristisch für die Sorten »Afus Ali«, »Ezerjó« (Tausendgut) und Furmint, eine prozentuale Häufigkeit wurde jedoch von keinem der Autoren veröffentlicht.

Die Stomazahl je Flächeneinheit und die Grösse wurden sowohl für die Weinrebe als auch für andere Pflanzen von zahlreichen Forschern untersucht. Mehrere haben Unterschiede zwischen Sorten und Klonen festgestellt (an Riesling-Klonen SIEVERS 1971, an *Dactylis-glomerata*-Sorten SCHÄFER und TIRTAPRADJA 1970), andere haben dagegen die ökologisch bedingten Unterschiede nachgewiesen (an Mais: SIMON-WOLCSÁNSZKY und MOLNÁROS 1971). Auch wir meinen, dass die Stomazahl von beiden Faktoren beeinflusst ist.

Material und Methoden

Die klassische Methode der Blattepidermis-Untersuchung bedient sich der Anfertigung von Blattabzügen, doch stösst dies bei den Rebenblättern (*Vitis* sp.) auf grosse Schwierigkeiten. Auch die Herstellung von Flächenschnitten ist mühsam und zudem sind auf diese Weise brauchbare Flächen nur von Bruchteilen eines Quadratmillimeters gewonnen worden. Wollen wir aber

statistische Analysen über die Zahl und Grösse der Stomata durchführen, bleibt diese Methode unzureichend. Deshalb haben wir die Methode der Kollodiumabdrücke gewählt, nach der zur Untersuchung grössere Flächen geeignete Abdrücke hergestellt werden können. Diese Methode ist nicht neu, da sie FLÖGEL (1870) vor mehr als hundert Jahren zur Herstellung von Diatomeen-Schalenabdrücken angewandt hat und auch Blattabdrücke nach diesem Verfahren schon lange gewonnen werden (BUSCALONI-POLLACCI 1901; zit. nach STRASBURGER 1902). In jüngster Zeit hat bei uns LOVAS (1960) die Methode der Kollodiumabdrücke in Verbindung mit der Verwendung eines 3D-Kondensors neu angewandt. Mit dieser Beleuchtungstechnik können sehr schöne, plastische Bilder der Präparate gewonnen werden, an denen zahlreiche Details wahrzunehmen sind, die an Epidermis Abzügen nicht zum Vorschein kommen.

In jüngster Zeit, zugleich mit uns, wird die Methode der Kollodiumabdrücke von mehreren Forschern angewandt (SCHÄFER und TIRTAPRADJA 1970, SIEVERS 1971).

Zur Anfertigung der Kollodiumabdrücke wurden frisch gesammelte Blätter benützt bzw. die Blätter, wenn das sofortige Präparieren nicht möglich war, in Kunststoffsäckchen getan und im Kühlschrank frisch gehalten. Für die Kollodiumabdrücke wurde die im Handel erhältliche Kollodiumlösung verwendet (nur selten eine Lösung von Celloidin in Amylacetat, vor allem für die Blattoberseite). Die Lösung wurde mit einem Pinsel in gleichmässiger, dünner Schicht auf etwa 2—3 cm^2 des mittleren Teiles des vollentwickelten Blattes aufgetragen und nach Trockung vorsichtig vom Blatt gelöst. Die besten Teile wurden mit einer Schere ausgeschnitten, auf den Objektträger gelegt und mit Deckglas trocken abgedeckt, wonach die Kanten des Deckglases mit Zellux-Klebeband fixiert wurden. Von stark wollhaarigen Blattunterseiten (z. B. an Blättern der Sorte Lindenblätter) wurde die Behaarung mit befeuchteten Fingern abgerieben, da die Epidermis nur in diesem Falle für die Untersuchung geeignet ist. Die Präparate wurden im Mikroskop mit 3D-Kondensor bei geneigtem Strahlengang untersucht, die Messungen und Zählungen dagegen mit Hilfe eines Visopan-Mikroskops durchgeführt. Die untersuchten Blätter wurden zu verschiedenen Zeitpunkten in den Budapester und Provinz-Weinanlagen des Instituts gesammelt. Ein Teil der Ergebnisse wurde bereits veröffentlicht (HEGEDÜS 1969), über weitere Ergebnisse wird hier berichtet. Die ausgezeichneten plastischen Aufnahmen wurden von B. LOVAS angefertigt, ihm danken wir auch bei dieser Gelegenheit für seine Unterstützung.

Untersuchungsergebnisse

Die Kollodiumabdrücke sind für das Studium der Cuticularfalten, der Zahl der Spaltöffnungen und ihrer Verteilung nach Typen sowie der Dichte der Nervatur vorzüglich geeignet. In unserem vorliegenden Bericht beschreiben wir die Zahl der Stomata und ihre Verteilung nach Typen bei *Vitis-vinifera*-Mustern aus Budapest und bei aus Eger stammenden Blättern von Unterlagensorten, ausserdem die Dichte der Nervatur von *Vinifera*-Sorten mehrerer Standorte sowie die Epidermisentwicklung der Sorte Médoc noir.

Zur Verteilung der Spaltöffnungen nach Typen soll vorweg festgehalten werden, dass zwei Grenzlagen zu unterscheiden sind: an der Oberfläche liegende Stomata (Abb. 6), wobei sich die Schliesszellen in ihrer ganzen Breite an der Epidermisoberfläche befinden, und tief eingesenkte Stomata (Abb. 5), wobei die Schliesszellen unter den umgebenden Epidermiszellen liegen. Zwischen diesen beiden Grenzlagen findet sich eine vollständige Reihe von Übergängen. Das Mass der Einsenkung lässt sich am besten durch die Spaltöffnungsbreite bzw. durch das Verhältnis der Länge zur Breite charakterisieren. In unseren früher veröffentlichten Untersuchungen (HEGEDÜS 1969) haben wir die zwei Grenzlagen als eigene Typen betrachtet, sämtliche Übergangsstadien hingegen in den halb eingesenkten Typ eingeordnet. Theoretisch scheint dies die logischste Aufteilung zu sein, nach den Ergebnissen unserer neueren Unter-

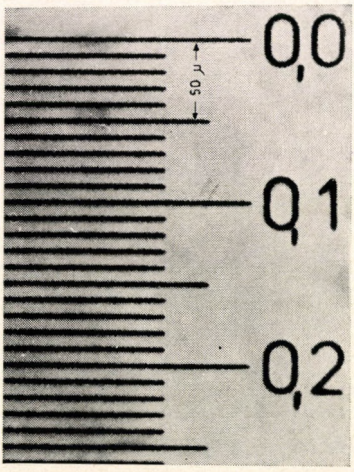

Abb. 1. Blattoberseite von Afus Ali. Grobe Cuticularfaltung. Sämtliche Aufnahmen stellen Kollodiumabdrücke dar. Vergrösserung 415 : 1. Die Aufnahmen stammen von B. Lovas

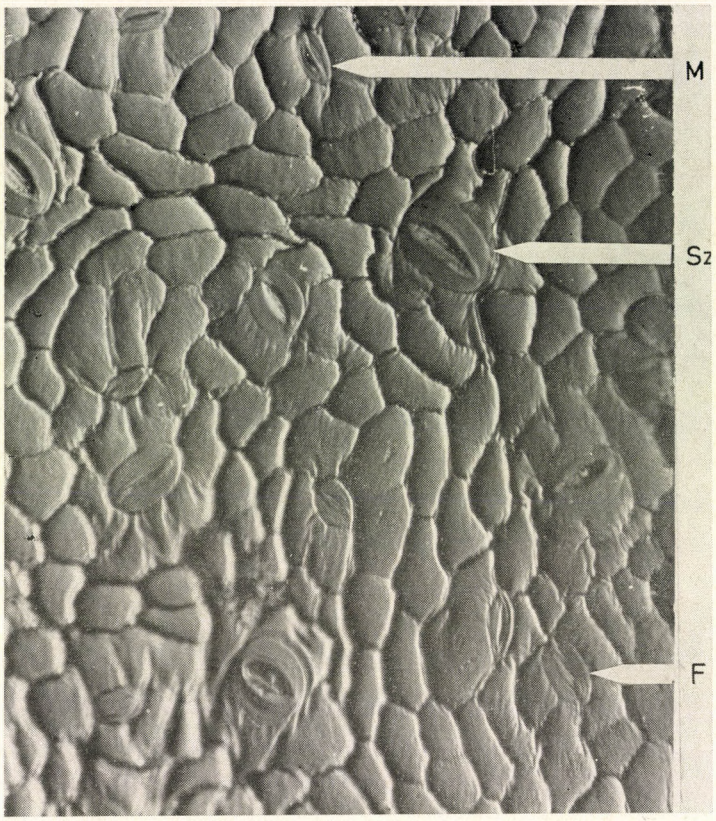

Abb. 2. Blattunterseite von Afus Ali. Die Epidermiszellen sind kleiner. Kutikula kaum wahrnehmbar gerunzelt. Oberflächliche (sz), halb eingesenkte (F) und tief eingesenkte (M) Spaltöffnungen kommen in gleichem Verhältnis vor

suchungen halten wir es jedoch für zweckmässig, diese frühere Auffassung zu revidieren. Die Übergangstypen, bei denen von den Schliesszellen nur noch ein schmaler Saum sichtbar ist, stehen nämlich praktisch dem tief eingesenkten Typ näher als dem halb eingesenkten Typ, weshalb wir diesen bei unseren neuesten Untersuchungen dem tief eingesenkten Typ zugeordnet haben (s. die schmalen Stomata in Abb. 12). Auf diese Weise wurde die Typengrenze zwischen den tief und den halb eingesenkten Typen ein wenig verschoben, wie das der hier folgenden Tabelle 1 zu entnehmen ist (1. Tabelle).

Aufgrund dieser neuen Aufteilung haben wir Budapester *Vinifera*- und Unterlagen-Proben aus Eger auf Kollodiumabdrücken untersucht und die prozentuale Verteilung der Spaltöffnungen ermittelt (Tabelle 2). Aus dieser Tabelle geht hervor, dass die Sorten voneinander sowohl in der Dichte der Stomata als auch in ihrer prozentualen Verteilung sehr erheblich abweichen. Aufgrund der Aufteilung der Spaltöffnungen nach Typen, können die Sorten in drei Gruppen eingereiht werden:

Tabelle 1

Frühere und neuere Abgrenzung der Spaltöffnungstypen

Grösse bzw. Verhältnis		In der Oberflächenebene liegend	Halb eingesenkt	Tief eingesenkt
Breite μ	früher	18 —24	7 —17	3 —6
	neu	18 —24	10 —17	3 —9
Länge : Breite	früher	1,0— 1,5	1,6— 3,5	3,6—6,0
	neu	1,0— 1,5	1,6— 1,9	2,0—6,0

Tabelle 2

Spaltöffnungsverteilung auf der Blattunterseite von Vitis vinifera und den Unterlagensorten

Sorte	Stomazahl je mm²	Prozentuale Verteilung nach Typen		
		in der Oberflächenebene liegend	halb eingesenkt	tief eingesenkt
Sultanine	216	29,9	36,6	33,5
Afus Ali	194	31,0	38,8	30,2
Portugieser	206	35,6	40,8	23,6
»Hárslevelű«	226	48,7	27,7	23,6
Pinot gris	164	62,9	29,0	8,1
»Kocsis Irma«	162	47,6	32,6	19,8
Weisse Gutedel	183	76,1	19,3	4,6
Müller-Thurgan	158	66,6	29,5	3,9
5C*	209	74,5	18,2	7,3
du Lot**	171	92,4	6,4	1,2
Portalis***	194	98,2	1,6	0,2
$GD_{5\%}$	30	8,7	7,5	8,5

* *Vitis Berlandieri* × *riparia*
** *Vitis rupestris*
*** *Vitis riparia*

1 Die eingesenkten Spaltöffnungen herrschen vor (Sultanine, Afus Ali, Portugieser)

2. Die Zahl der eingesenkten ist jener der oberflächennahen Spaltöffnungen annährend gleich (Hárslevelű (Lindenblättler), »Kocsis Irma«)

3. Es dominieren die oberflächennahen Spaltöffnungen (Pinot gris, weisse Gutedel, Müller-Thurgau, Teleki 5C)

4. Beinahe ausschliesslich oberflächennahe Spaltöffnungen (du Lot, Portalis)

Abb. 3. Blattoberseite von »Hárslevelű« (Lindenblätter). Am Zellrand kleine kutikulare Rippen. Die Zellen mit groben Runzeln, die über der Nervatur parallel zur Längsachse der Ader verlaufen

Diese Daten lassen darauf schliessen, dass die Rebensorten auch durch die Lage der Spaltöffnungen auf der Blattunterseite charakterisiert werden können.

Die Stomazahl je Flächeneinheit ist weitgehend durch die Grösse der übrigen Epidermiszellen bestimmt. Aus den Abbildungen dieses Beitrages geht hervor, dass die Epidermiszellen nicht gleichförmig sind; auf der Blattunterseite von Afus Ali (Abb. 2) z. B. sind die Zellen viel kleiner als auf der Blattunterseite der Sorte »Kocsis Irma« (Abb. 4). Es versteht sich von selbst, dass die Zahl der Spaltöffnungen je Flächeneinheit bei kleineren Zellen grösser ist als bei grösseren Zellen. Der Tabelle 2 ist zu entnehmen, dass sich auf der Blattunterseite von Afus Ali eine signifikant grössere Zahl von Stomata befindet als auf der Blattunterseite der Sorte »Kocsis Irma«. Die infolge der Unterschiede im Wachstum der Epidermiszellen entstehenden Abweichungen in den Stomazahlen wurden von mehreren Forschern mittels eines Stomaindexes

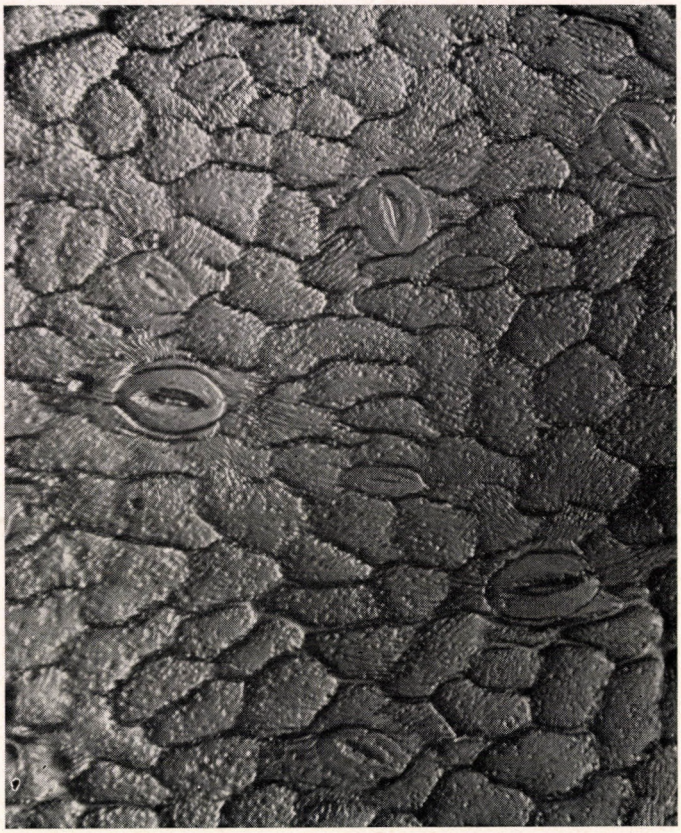

Abb. 4. Blattunterseite von »Kocsis Irma«. Kutikula mit feinen Tüpfeln, um die Spaltöffnungen geringe Faltung. Die Mehrzahl der Stomata liegt in der Oberflächenebene

eliminiert (VERZÁR-PETRI 1971). Diese Messziffer, der Quotient aus der Stoma- und der Epidermiszellenzahl je Flächeneinheit, kann aber nur durch zeitraubendes Zählen ermittelt werden. Darum halten wir es für zweckmässiger, die Dichte der Nervatur durch Messung der Grösse der von den schmalen Nerven umgebenen Blattflächen, der sog. Intercostalfelder festzustellen.

Mit der Dichte der Nervatur von Reben hat sich TRIPPI (1965) befasst. Er fand, dass die Dichte der Nervatur mit dem Alter des Weinstockes zunimmt. Auf anderen Pflanzen hat TUMANOW (1927) festgestellt, dass sich unter trokkenen Verhältnissen eine dichtere Nervatur entwickelt, GUPTA (1961) dagegen beobachtete, dass die Nervatur auf grösseren Blättern spärlicher ist, was so viel bedeutet, dass das Produkt aus Blattfläche und Zahl der Intercostalfelder je Flächeneinheit konstant ist. Es wurde an einigen Sorten untersucht, inwiefern die Dichte der Nervatur von der Sorte und dem Standort beeinflusst wird. Da die Grösse der Intercostalfelder variabel ist, bestimmten wir je

Abb. 5. Blattoberseite von Oporto, vom Rande der Hauptader. Tief eingesenkte Spaltöffnungen, um sie befinden sich charakteristisch angeschwollene Zellen mit radial gefalteter Kutikula

Tabelle 3

Distanz zwischen den Adern in μ

	Miklóstelep	Pécs	Eger	Durchschnitt
Gutedel	362	423	412	399
Afus Ali	503	489	481	491
Limberger	430	412	413	418
Mädchentraube	426	454	496	459
Portugieser	418	449	391	419
Durchschnitt	428	445	439	437

GD-Komb. = 34 GD-Ort = 15 GD-Sorte = 20

Abb. 6. 5C-Blattunterseite. Der Grossteil der Spaltöffnungen liegt in der Oberflächenebene. Cuticularfaltung nur in der Nähe der Stomata

Sorte und Standort 100 Intercostalfelddurchmesser, um auf diese Weise gute Mittelwerte zu gewinnen. Aus den Ergebnissen geht hervor (Tabelle 3), dass sich zwar auch je nach dem Standort signifikante Differenzen zeigten, aber die Abweichungen je nach den einzelnen Sorten bedeutend grösser waren. Die Sorte Gutedel hat die dichteste Nervatur, Afus Ali hingegen die spärlichste. Zwischen diesen beiden zeigte sich eine fünffache Grenzdifferenz.

Die Kollodiumabdrücke sind für die Untersuchung der Feinstruktur von Epidermisoberflächen vorzüglich geeignet. Die Epidermisoberfläche zeigt gröbere Cuticularfalten (Abb. 1, 3, 7), aber auch hierin zeigen sich Unterschiede je nach der Sorte. Die Blattunterseiten der *Vinifera*-Sorten sind häufig ganz frei von Cuticularfalten oder nur an den Zellen unmittelbar neben den Spaltöffnungen minimal gerunzelt (Abb. 2, 4). Die Blattunterseite der Unterlagensorten ist rings um die Stomata ausdrücklicher gerunzelt (Abb. 6), ja die Runzeln erstrecken sich sogar auf den grösseren Teil der Oberfläche (Abb. 8).

Abb. 7. Blattoberseite von du Lot. Grob gerunzelte Kutikula

Zu bemerken ist jedoch, dass das Mass der Runzelung individuell unterschiedlich sein kann.

Der Differenzierungsprozess an der unteren Blattepidermis der Sorte Médoc noir wurde an Kollodiumabdrücken von in Entwicklung begriffenen Blättern studiert (Abb. 9—12). Es wurden sämtliche Blätter von 5 Sprössen untersucht und die Spaltöffnungszahlen und Typen nach Grösse und Entwicklungsstadium der Blätter gruppenweise summiert (Tabelle 4). Auf einem Blatt mit einem Durchmesser von 1—2 cm sind entwickelte Stomata kaum zu finden, dagegen ist die Zahl der wahrnehmbaren Spaltöffnungsmutterzellen bzw. der in Entwicklung begriffenen Spaltöffnungen sehr hoch. Von einem so kleinen Blatt lassen sich keine guten Kollodiumabdrücke anfertigen, da sich die in Entwicklung begriffene Blattanlage noch im gefalteten Stadium befindet und ihre Ausbreitung die Zerbröckelung zur Folge hat. Ein guter Abdruck kann von Blättern mit 5—7 cm Durchmesser angefertigt werden (Abb. 9). Auf solchen Blättern wurde festgestellt, dass die sich entwickelnden Spaltöffnungen weit

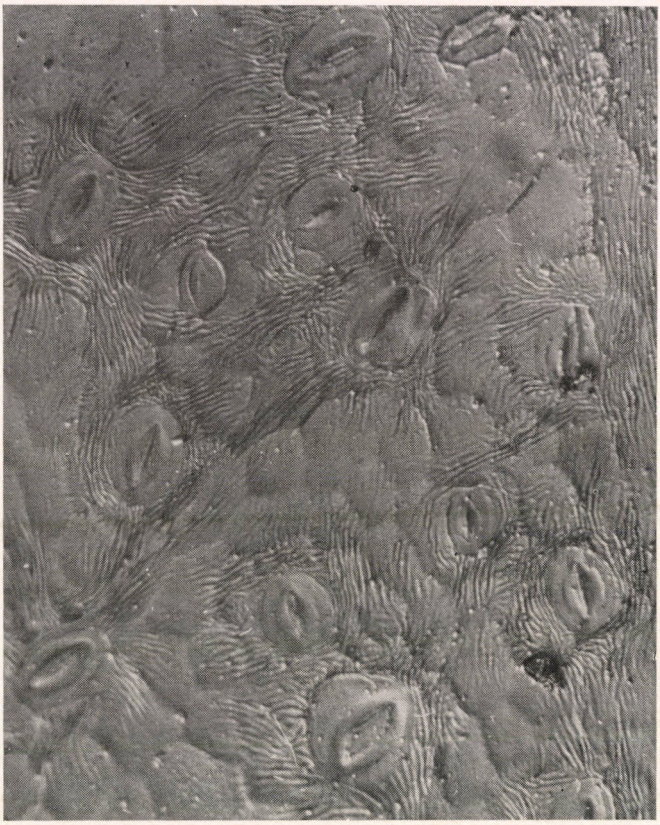

Abb. 8. Blattunterseite von du Lot. Der Grossteil der Spaltöffnungen liegt in der Oberflächenebene. Um die Spaltöffnungen im grösseren Kreis gerunzelte Kutikula

Tabelle 4

Spaltöffnungsverteilung auf im Wachstum begriffenen Blättern von Vitis vinifera cv. Médoc noir

Blattbreite	Blattfläche ca. cm^2	Stomazahl je mm^2	Prozentuale Verteilung der Stomatypen			
			in der Oberflächenebene liegend	halb eingesenkt	tief eingesenkt	in Entwicklung begriffen
13,5—18,0	150	293	41,4	57,5	0,9	0
10,1—14,0	100	362	34,9	24,7	0,1	40,3
7,1—10,0	50	496	31,4	0	0	68,6
5,6— 7,0	25	330	24,2	0	0	75,8
4,6— 5,5	15	330	20,0	0	0	80,0
3,1— 4,5	8	132	11,2	0	0	88,8
2,1— 3,0	4	78	2,6	0	0	97,4
1,1— 2,0	1	37	2,8	0	0	97,2

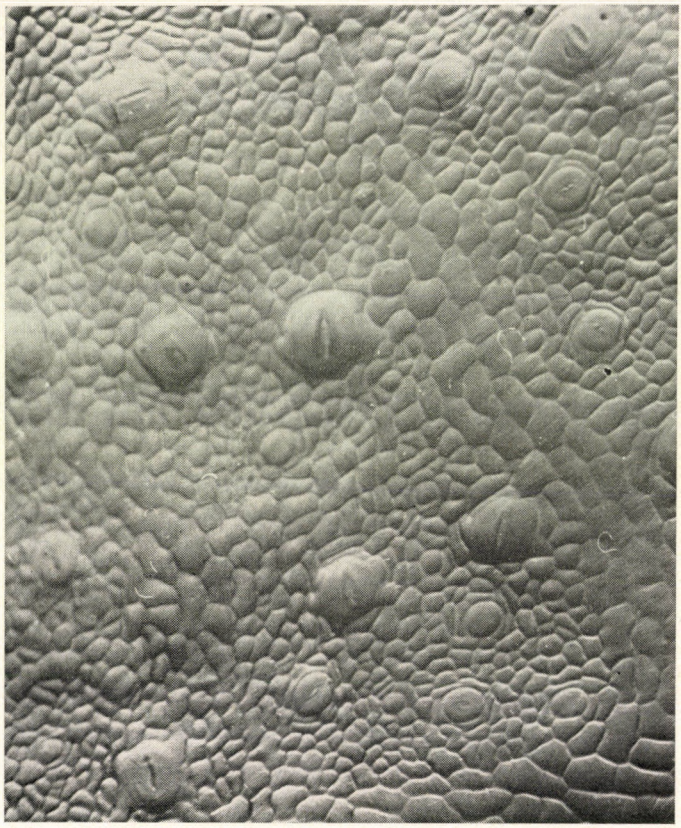

Abb. 9. Unterseite des unentwickelten (Durchmesser 6,4 cm) Blattes von Médoc noir. Die in Entwicklung begriffenen Epidermiszellen sind noch ganz klein. Die Stomata und die sich entfaltenden Stomamutterzellen heben sich ab. Die Epidermiszellen über den Adern sind noch isodiametrisch

schneller wachsen als die umliegenden Protodermzellen und dass sie sich anfangs von der Protodermoberfläche stark abheben. Auf einem Blatt mit dem Durchmesser von 11 cm (Abb. 10) finden sich bereits ziemlich viele entwickelte Stomata, der grössere Teil der Spaltöffnungen ist jedoch noch in Entwicklung begriffen. Auf einem Blatt mit dem Durchmesser von 14 cm, also auf einem nahezu völlig entwickelten Blatt (Abb. 11) befinden sich noch immer sich entwickelnde Stomata, doch hat die Einsenkung einzelner Spaltöffnungen in die Oberfläche bereits begonnen. Die untere Epidermis des im Durchmesser 17 cm grossen Blattes (Abb. 12) ist vollständig entwickelt, der Grossteil der Spaltöffnungen ist mehr oder minder tief unter die Epidermisoberfläche gesunken. In der Entwicklung der Spaltöffnungen können demnach zwei gegensätzliche Prozesse unterschieden werden: anfangs heben sich die Schliesszellen von der Oberfläche ab und drücken infolge ihrer kräftigen Entwicklung

Abb. 10. Unterseite eines in Entwicklung begriffenen Blattes (Durchmesser 11,1 cm) von Médoc noir. Die Zellen sind grösser, doch gibt es noch immer viele sich entwickelnde Stomata bzw. Stomamutterzellen. Die Zellen über den Adern sind bereits ein wenig verlängert

die umliegenden Protodermzellen zusammen; im nächsten Abschnitt zeigen die Epidermiszellen eine kraftvollere Entwicklung und drücken die Schliesszellen unter die Oberfläche.

Die einzelnen Stomata entfalten sich nicht zu gleicher Zeit, somit können auf dem wachsenden Blatt ausser vollentwickelten Spaltöffnungen auch auf verschiedenen früheren Entwicklungsstufen stehende gefunden werden. Es ist ein charakteristischer Zug der Stomatenwicklung, dass auf der Unterseite der noch im Wachstum begriffenen 4,6 —14 cm breiten Blätter die Zahl sämtlicher (sich entfaltender und vollentwickelter) Spaltöffnungen je Flächeneinheit höher ist als die der Stomata auf den vollentwickelten, 14 —18 cm breiten Blättern (Tabelle 4). Das ist darauf zurückzuführen, dass die Blattoberfläche nach der Entwicklung sämtlicher Spaltöffnungen weiter wächst, dass somit die tatsächliche Stomazahl unverändert bleibt und die Spaltöffnungszahl je Flächeneinheit abnimmt.

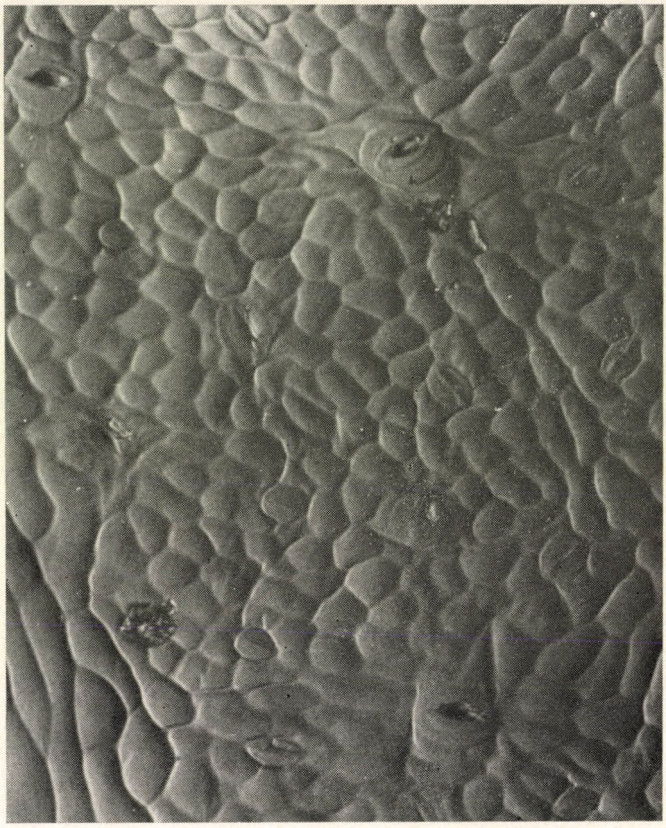

Abb. 11. Unterseite eines nahezu vollentwickelten Blattes (Durchmesser 13,8 cm) von Médoc noir. Die Spaltöffnungen sind weit stärker entwickelt als die des Blattes in Abb. 10

Zusammenfassung

Nach der hier dargelegten und auch nach den aufgrund der prozentualen Verteilung analysierten Daten sind für die Sorten »Sultanine«, Afus Ali und Portugieser mehrheitlich die eingesenkten Spaltöffnungen charakteristisch. Nach ISTVÁNFFI et al. sind einige Sorten (Fosters white Seedling, Gros Colman) durch emporragende Stomata gekennzeichnet. Solche Stomata haben wir auf Rebenblättern nicht entdecken können, auf Stielen konnten sie jedoch beobachtet werden. Auch diesen wenigen Daten ist zu entnehmen, dass die Häufigkeit der Spaltöffnungstypen ein kennzeichnendes Merkmal der einzelnen Sorten darstellt, dass aber die genaue Erkennung der Sorten noch zahlreiche weitere Untersuchungen erfordert. Die Tabelle 2 zeigt die Unterschiede nach Sorten.

Der Zusammenhang zwischen Stomazahl und Dichte der Nervatur konnte nicht befriedigend nachgewiesen werden, vor allem darum nicht, weil die beiden

Abb. 12. Unterseite eines vollentwickelten Blattes (Durchmesser 16,9 cm) von Médoc noir Der Grossteil der Spaltöffnungen ist eingesenkt

Untersuchungen nicht an ein und demselben Material vorgenommen wurden; ohne Zweifel konnte aber nachgewiesen werden, dass die Dichte der Nervatur nach der Ökologie und Sorten verschieden ist.

Die Beschreibung der Stomaentwicklung und ihre Darstellung auf Photoaufnahmen ist im Falle von Weinrebe ganz neu. Auffallend ist die schnelle Entwicklung der Stomamutterzellen und ihre Emporragen aus der Protodermoberfläche. In der letzten Periode der Stomaentwicklung sinken die Schliesszellen unter die Ebene der umliegenden Epidermisszellen ab.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 20 (3–4), pp. 271–280 (1974)

CATALOGUS ET ICONOGRAPHIA ALGARUM HUNGARIAE

Von

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(Eingegangen am 19. Februar 1974)

The author has compiled the iconography of the algae in Hungary. He treated the investigations of Hungarian authors on Hungarian materials, the collections of Hungarian authors made abroad, as well as the identifications of foreign authors made on Hungarian materials in the period 1967—1974. The work contains 62 118 data, deposited at the botany Department, University of Agrarian Sciences, Gödöllő (Hungary)

Die Entwicklung einer Disziplin erfordert es, ihre Ergebnisse von Zeit zu Zeit zusammenzufassen und kritisch zu bewerten. Damit können für die weitere Arbeit neue Gesichtspunkte gesetzt und für den gegebenen Wissenschaftszweig neue Mitarbeiter gewonnen werden. Als Arbeiten in diesem Sinne können wir aus der Geschichte der ungarischen Zoologie das Werk »Fauna Regni Hungariae« und dessen modernes Nachfolgewerk, die »Tierwelt Ungarns« nennen. Bekannt ist auch, welch grosse Bedeutung für die ungarische Botanik die Arbeit »Die Ungarische Flora« von S. JÁVORKA hatte, und welches Gewicht dem neuerdings veröffentlichten fünfbändigen Pflanzensystematisch-pflanzengeographischen Handbuch der ungarischen Flora und Vegetation von R. Soó beizumessen ist.

Wir haben nicht die Absicht, die Geschichte der ungarischen Algenkunde — sei es auch nur in grossen Zügen — zu erörtern. Hier sei lediglich darauf verwiesen, dass die ungarische Algenforschung seit ihren Anfängen Ende des vorigen Jahrhunderts bis auf den heutigen Tag ein reiches Material für die kritische Synthese angehäuft hat. Ausserdem dient die Algenforschung heute nicht nur der Erweiterung unserer biologischen Kenntnisse, vielmehr kommt ihr auch eine erhebliche praktische Bedeutung zu. Den Zeitpunkt für die erwähnte Synthese macht neuerdings ein weiterer Umstand aktuell. Die in internationalen Dimensionen in Entfaltung begriffene Umweltbiologie im Verein mit dem Naturschutz verlangt immer vordringlicher die tunlichst vielseitige Untersuchung der aquatischen Lebewesen.

Von diesen Gesichtspunkten geleitet, hat der Lehrstuhl für Botanik und Pflanzenphysiologie an der Agrarwissenschaftlichen Universität Gödöllő 1966 im Rahmen des Forschungsauftrages »Die Algen Ungarns« der Ungarischen Akademie der Wissenschaften die Sammlung des Datenmaterials über die Heimischen Algen aufgenommen. Die Arbeit setzt sich das Ziel, eine Basis

für die kritische Bearbeitung der ungarischen Algenflora zu schaffen. Entsprechend handelt es sich vor allem um eine Arbeit pflanzengeographisch-chorologisch-systematischen Charakters. Es wurden jedoch auch die in unseren Quellen figurierenden ökologischen oder biologischen Mitteilungen nicht ausser acht gelassen.

Die Datensammlung beschränkte sich bis Ende 1968 auf unser gegenwärtiges Landesterritorium. In dieser Phase blieben die Kieselalgen unberücksichtigt. Ab 1969 wurden auch die Kieselalgen bearbeitet, ab 1970 auch die Beobachtungen ungarischer Autoren über ausländisches Material registriert. Ausser den Daten über Algen wurden auch solche über aquatische Pilze und Bakterien gesammelt.

Die Ergebnisse wurden auf doppelreihige Randlochkarten — DDR-Fabrikat — getippt. Diese Lochkarten enthalten — aufgrund der Mitteilungen der Autoren — den Namen der Alge (Pilze, Bakterien), den Ort ihres Vorkommens, ihre Beschreibung, den Zeitpunkt der Beobachtung, die ökologischen Verhältnisse usw. Es wurde immer darauf geachtet, dass den einzelnen Beschreibungen auch die vom Autor mitgeteilten Illustrationen beigefügt blieben, da dies wegen der Identifikation oder Kontrolle wichtig ist. Auf diese Weise haben wir auch eine ungarische Algen-Ikonographie geschaffen, deren Bedeutung für die geplante kritische Revision nicht nachdrücklich genug betont werden kann.

Als Datenmaterial wurde jede im Druck bereits erschienene Publikation betrachtet, der zu entnehmen war, dass eine gewisse, mit Gattungs- und Artennamen versehene Alge auf dem Gebiet unseres Landes oder von ungarischen Forschern im Ausland beobachtet wurde. In Ausnahmefällen wurden auch die nur mit ihrem Gattungsnamen vermerkten Organismen registriert.

Die Sammlung der literarischen Data hat dank der begeisterten und gewissenhaften Mitarbeit von Dr. S. Tóth bereits 1966 begonnen, systematisch wurde sie aber ab 1967 durchgeführt. Zu dieser Zeit wurde Dr. S. Tóth als Sachbearbeiter zum Mitarbeiter des Lehrstuhls ernannt, u.zw. mit dem Auftrag, die technischen Arbeiten zu verrichten. Eine kürzere Zeit lang nahm an dieser Arbeit als Sachbearbeiterin der Ung. Akad. d. Wiss. auch Frau J. Bakos teil. Externe Mitarbeiter halfen besonders im Maschineschreiben und in der Ordnung der Data. An dieser Arbeit beteiligten sich auch einige Mitglieder unseres Lehrstuhls.

Ein grosser Vorteil war es, dass zu Beginn der Arbeiten ein etwa 1000 Karten und mehrere tausend Data umfassender Zettelkatalog zur Verfügung stand, der für den einigen Gebrauch, aber zu ähnlichen Zwecken von T. Hortobágyi zusammengestellt worden war. Diese Sammlung ist im Laufe der Arbeit in die neue Sammlung aufgegangen, ihre Abbildungen und manchmal auch die Texte wurden auf die neuen Karten geklebt.

Verhältnismässig leicht konnte ein wesentlicher Teil der ungarischen

Algenliteratur anhand der Sonderdrucksammlung von T. HORTOBÁGYI zusammengestellt werden. Die weitere Literatur fand sich grösstenteils in der Bibliothek der Botanischen Sektion des Naturhistorischen Museums. Diese Bibliothek trug zum Erfolg unserer Arbeit nicht nur dank der Fülle der dort aufbewahrten reichen Fachliteratur, sondern auch dank der Hilfsbereitschaft der dort arbeitenden Bibliothekare wesentlich bei. Umfangreiche Literatur zur Erreichung unserer Ziele stellen uns die Bibliotheken folgender Institutionen zur Verfügung: Bibliothek der Agrarwissenschaftlichen Universität Gödöllő, Bibliothek des Ungarischen Geologischen Instituts, weiterhin die der Zoologischen Sektion des Naturhistorischen Museums, die Bibliotheken der Lehrstühle für Pflanzensystematik, Zoosystematik und Mikrobiologie der L. EÖTVÖS-Universität Budapest. In einigen Fällen mussten die benötigten Abhandlungen im internationalen Leihverkehr aus dem Ausland bezogen werden. Ausserdem haben uns auch die aktiven Autoren besonders durch die leihweise Überlassung jener ihrer Abhandlungen unterstützt, deren Anschaffung auf Schwierigkeiten stiess, aber auch durch die Zusendung ihrer jüngst veröffentlichten Publikationen.

Die Illustrationen im Original beizufügen ist uns nicht immer gelungen. In solchen Fällen wurden die Originalillustrationen zunächst durch Handzeichnungen, später durch Photo bzw. Xerox-Kopien ersetzt. Manchmal waren die veröffentlichten mikroskopischen Aufnahmen derart verschwommen, dass wir es für besser hielten, sie ganz wegzulassen.

Nach der Überwindung grösserer-kleinerer Schwierigkeiten war es 1972 so weit, dass wir die Arbeit — von einigen Einzeldaten abgesehen — als beendet ansehen konnten. Seitdem sind auch die fehlenden Daten nachgetragen und auch die neuesten Mitteilungen bearbeitet worden. Das Material steht in Buchstabenfolge der Organismen als Rohmaterial für die kritische Bearbeitung fertig. Natürlich besagt das nicht, dass die Sammeltätigkeit damit abgeschlossen wäre. Die nachträgliche Aufnahme der neueren Mitteilungen ist auch weiterhin notwendig.

Die numerischen Data der Arbeit sind im Register Nr. 2 enthalten. Nach dem Endergebnis des Registers haben wir 62 118 Daten aus 1101 Studien von 220 Autoren bearbeitet. In unserem Register beziehen sich die mit »M« vermerkten »ungarischen« Daten auf das Gebiet innerhalb unserer gegenwärtigen Landesgrenzen. Die Daten, die sich auf ein grösseres Landesgebiet beziehen, wurden ebenso als die ausländischen Angaben mit dem Buchstaben »K« bezeichnet. Entsprechend geschah auch die Unterscheidung der einzelnen Abhandlungen. Enthielt eine Abhandlung sowohl »M«-, als auch »K«-Data, erfolgte ihre Einreihung je nachdem, welche in der Mehrzahl waren. Die Angaben der Studien mit mehreren Autoren wurden nach dem Namen eines einzigen Autors registriert; so konnte es in einigen Fällen geschehen, dass gerade jener Autor genannt wurde, der mit der Algenforschung nichts zu

tun hatte. Die tatsächlichen Verhältnisse konnten in diesen Fällen nicht festgestellt werden. Die Mitteilungen jener Autoren, die insgesamt 1000 oder noch mehr Daten geliefert haben, wurden im Register hervorgehoben

Über den Arbeitsverlauf gibt Register Nr. 1 Bescheid.

Register Nr. 1

September	1967	13	Autoren	220	Studien	13 277	Data
Oktober	1968	91	Autoren	429	Studien	29 471	Data
September	1969	128	Autoren	623	Studien	41 472	Data
Dezember	1970	147	Autoren	742	Studien	49 157	Data
Dezember	1971	175	Autoren	892	Studien	54 159	Data
Dezember	1972	193	Autoren	1032	Studien	58 137	Data
Dezember	1973	199	Autoren	1058	Studien	60 208	Data
Dezember	1974	220	Autoren	1101	Studien	62 118	Data

Aus dem Register geht hervor, wie sehr es uns anfänglich zugute kam, dass die Abhandlungen entweder vorlagen, oder nur der bereits fertige Zettelkatalog umgearbeitet zu werden brauchte. Zu dieser Zeit konnte die Revision und das Ordnen der Data mit wesentlich weniger Arbeitskräften bewältigt werden. Im weiteren verlangsamte sich die Arbeit infolge des kontinuierlichen Ordnens, der Anfertigung der Register und wegen der Schwierigkeiten in der Beschaffung der fehlenden Studien wesentlich. 1972 warf das Auffinden der noch fehlenden Abhandlungen grosse Probleme auf.

Die Datensammlung, die was den Zeitaufwand und die aufgenommene Datenmenge anlangt, als bedeutendes Werk betrachtet werden kann, befindet sich in zwei verschlossenen Schränken am Lehrstuhl für Botanik und Pflanzenphysiologie der Agrarwissenschaftlichen Universität Gödöllő.

Register Nr. 2

Numerische Aufzählung der Autoren, der bearbeiteten Werke und Daten
(M = ungarisch, K = ausländisch, — = Arbeit bzw. Angabe mehrerer Autoren)

Autor	M	K	—	M	K	—
	Arbeit			Angabe		
Andrik, P.	1	—	—	19	—	—
Antos, T.	—	—	1	—	—	221
Bancsi, I.	—	—	1	—	—	114
Bartha, Zs.	1	—	—	13	—	—
Bánáti, M.	—	—	2	—	—	186
Bedő, I.	—	—	1	—	—	2
Benkő, G.	—	1	—	—	5	—
Berczik, Á.	1	—	—	1	—	—
Beretzk, P.	—	—	2	—	—	166
— Bérczi, L.	1	—	—	24	—	—
Biebl, H.	—	—	1	—	—	9
Biró, P.	—	—	1	—	—	114
Biró, Zs.	—	—	4	—	—	252
Bodrogközy, Gy.	1	—	—	84	—	—
Bolla, J.	—	1	—	—	35	—
Bolberitz, K.	—	—	1	—	—	86
Borbás, V.	5	—	—	121	—	—
Boros, Á.	8	—	—	89	—	—
Bozzay, E.	—	—	3	—	—	209
— Chodat, F.	—	—	2	—	—	48
Cholnoky, B.	34	1	—	*1 305*	*82*	—
Claus, G.	6	—	—	319	—	—
Csanády, M.	1	—	—	4	—	—
Csató, J.	—	1	—	—	13	—
Cseh, E.	—	—	2	—	—	2
Csekei, T.	—	—	1	—	—	114
Csongor, Gy.	—	—	2	—	—	166
Daday, J.	2	8	—	66	321	—
Degen, Á.	1	—	—	2	—	—
— Demeter, K.	—	1	—	—	3	—
Demetzky, Gy.	1	—	—	1	—	—
Domján, Á.	2	—	—	98	—	—
Donászy, E.	3	—	—	70	—	—
Dvihally, Zs.	1	—	—	48	—	—
Elekes, K.	—	—	1	—	—	1
Endlicher, St.	—	1	—	—	13	—

(*Register No. 2*)

Autor	M Arbeit	K Arbeit	— Arbeit	M Angabe	K Angabe	— Angabe
Entz, B.	1	—	1	1	—	1
Entz, G. jun.	28	4	—	573	135	—
Entz, G. sen.	1	9	—	1	121	—
– Erdei, L.	1	—	—	1	—	—
Estók, B.	—	—	1	—	—	8
Eurola, S.	—	—	1	—	—	24
Éber, Z.	1	1	—	13	466	—
Farkas, T.	1	—	—	2	—	—
Fázold, Á.	—	—	6	—	—	296
Fehér, D.	—	2	2	—	*1 105*	*12*
Felföldy, L.	13	—	2	42	—	2
Filarszky, N.	11	5	—	*376*	*909*	—
Flint, E. A.	—	—	1	—	—	6
50— Fott, B.	1	—	—	3	—	—
Francé, R.	10	2	—	294	68	—
Frank, F.	1	—	—	15	—	—
Fridvalszky, L.	2	—	—	2	—	—
Gallik, O.	4	—	—	294	—	—
Gáyer, Gy.	—	—	1	—	—	2
Geitler, L.	1	3	—	12	9	—
Gelei, J.	1	1	3	3	1	67
Gellért, J.	—	—	6	—	—	619
Gimesi, N.	5	1	—	8	3	—
— Gondozó, Gy.	—	—	1	—	—	217
Gönczöl, J.	1	—	—	51	—	—
Gregács, M.	—	—	4	—	—	96
Greguss, P.	—	3	—	—	401	—
Grunow, A.	5	—	—	118	—	—
Gyarmati, P.	—	—	1	—	—	139
Győrffy, I.	1	2	—	2	6	—
Gyurkó, P.	—	—	2	—	—	52
Hajdú, L.	2	—	1	10	—	1
Hajós, M.	17	1	—	*1113*	33	—
— Halász, M.	10	2	—	536	138	—
Hamar, J.	2	—	—	189	—	—
Haranghy, L.	1	—	—	1	—	—
Hazslinszky, Fr.	2	1	—	313	336	—

(*Register Nr. 2*)

Autor	M Arbeit	K Arbeit	— Arbeit	M Angabe	K Angabe	— Angabe
Hegedűs, J.	1	—	—	93	—	—
Hegedűs, J.-né	—	—	1	—	—	93
Hegyessy, L.	—	—	1	—	—	86
Herodek, S.	—	—	1	—	—	24
Heufler, L.	1	—	—	2	—	—
Hevesi, A.	2	—	—	78	—	—
— Hoek, C. van den	—	1	—	2	—	—
Hollós, L.	1	—	—	3	—	—
Holzer, H. F.	—	—	1	—	—	33
Hortobágyi, T.	123	14	—	*7 690*	*1298*	—
Horváth, A.	—	—	2	—	—	166
Höfler, K.	—	—	1	—	—	24
Hustedt, Fr.	1	1	—	49	220	—
Istvánffi, Gy.	6	27	—	*591*	*1 679*	—
Jaczó, I.	—	—	1	—	—	48
Jurányi, L.	1	—	—	1	—	—
— Kalchbrenner, K.	—	1	—	—	257	—
Kalkó, Zs.	—	—	3	—	—	21
Kamptner, E.	—	1	—	—	3	—
Kánitz, Á.	1	—	—	2	—	—
Karl, J.	1	—	—	4	—	—
Kárpáti, Á.	1	—	4	2	—	193
Kedves, M.	1	—	—	2	—	—
Kender, J.	1	—	—	2	—	—
Kertész, M.	—	1	—	—	36	—
Kiss, Á.	4	—	—	372	—	—
100— Kiss, Gy.	—	—	1	—	—	114
Kiss, I.	27	—	—	*1 308*	—	—
Klein, Gy.	—	1	—	—	18	—
Kol, E.	33	69	—	*3 095*	*2 074*	—
Kolaczek, E.	—	1	—	—	1	—
Kolosváry, G.	—	—	2	—	—	166
Komáromy, Zs.	1	—	—	22	—	—
Koren, I.	2	—	—	27	—	—
Kottász, J.	—	—	1	—	—	152
Körfy, L.	—	—	1	—	—	8
— Kovács, A.	—	—	2	—	—	2

(*Register Nr. 2*)

Autor	M Arbeit	K Arbeit	— Arbeit	M Angabe	K Angabe	— Angabe
Kovács, M.	—	—	1	—	—	1
Krenner, J. A.	—	1	—	—	93	—
Krepuska, Gy.	2	—	—	169	—	—
Kümmerle, J. B.	2	—	—	4	—	—
Lacsny, I. L.	—	3	—	—	250	—
Langer, S.	4	2	—	157	99	—
Lengyel, A.	—	—	1	—	—	4
Machay, L.	1	—	1	2	—	8
Mahunka, S.	1	—	—	4	—	—
— Mann, H.	1	—	—	48	—	—
Manninger, R.	—	—	1	—	—	33
Margittay, A.	—	1	—	—	4	—
Margó, T.	1	—	—	35	—	—
Mágocsy-Dietz, S.	1	—	—	1	—	—
Marián, M.	—	—	1	—	—	67
Márton, G.	1	—	—	1	—	—
Marton, M.	—	—	1	—	—	18
Maucha, R.	2	—	—	13	—	—
Megyeri, J.	2	—	2	11	—	247
— Meszes, G.	—	—	1	—	—	1
Mihály, E.	1	—	—	3	—	—
Mihályi, F.	1	—	—	1	—	—
Mika, K.	—	1	—	—	19	—
Moesz, G.	—	3	—	—	333	—
Mollenhauer, D.-R.	—	1	—	—	1	—
Morvai, T.	—	—	1	—	—	114
Muhits, K.	2	—	—	93	—	—
Nagy, I.	2	—	—	64	—	—
Nemes, Z.	—	—	2	—	—	2
— Neupauer, J.	1	—	—	190	—	—
Némedi, L.	—	—	1	—	—	93
Németh, J.	—	—	2	—	—	133
Novák, E. K.	—	—	1	—	—	5
Oláh, J.	2	1	2	3	9	115
Overbeck, J.	—	—	1	—	—	9
Pálfalvy, I.	—	—	4	—	—	93
Palik, P.	31	2	—	584	108	—

(Register Nr. 2)

Autor	M Arbeit	K Arbeit	— Arbeit	M Angabe	K Angabe	— Angabe
Pantocsek, J.	5	11	—	*1 148*	*2 018*	—
Papp, Sz.	—	—	1	—	—	86
150— Parádi, K.	—	1	—	—	3	—
Pascher, A.	1	—	—	10	—	—
Pákh, E.	4	2	—	49	93	—
Pax, F.	—	1	—	—	25	—
Pia, J.	—	1	—	—	7	—
Ponyi, J.	2	—	4	4	—	242
Ponyi-Zánkai, N.	—	—	2	—	—	115
Quint, J.	3	1	—	198	62	—
Radócz, Gy.	—	—	1	—	—	76
Raineri, R.	1	—	—	48	—	—
— Rakován, J.	1	—	—	1	—	—
Ruttkay, A.	2	—	—	3	—	—
Safranko, E.	—	—	1	—	—	221
Salah, M.	—	—	2	—	—	96
Sáray, G.	1	—	—	4	—	—
Schedae Au.-H.	1	—	—	15	—	—
Schedae Hung.	1	—	—	48	—	—
Scheffer, J.	—	—	1	—	—	2
Scheitz, A.	1	1	—	11	5	—
Scherffel, A.	9	25	—	198	453	—
— Schiefner, K.	12	—	—	611	—	—
Schiller, J,	1	6	—	1	97	—
Schmidt, A.	—	—	1	—	—	15
Schmidt, G.	1	—	—	47	—	—
Schmidt, G. W.	—	—	1	—	—	28
Schumann, J.	—	1	—	—	205	—
Sebestyén, O.	22	—	8	111	—	197
Simonkai, L.	—	2	—	—	10	—
Simor, J.	—	—	1	—	—	15
Staub, M.	1	2	—	*447*	*661*	—
— Stefan, F.	—	—	1	—	—	1
Stiller, J.	3	—	1	104	—	2
Ström, K. M.	—	1	—	—	12	—
Suba, É.	1	—	—	41	—	—
Szabados, A.	2	—	—	135	—	—

(Register Nr. 2)

Autor	M Arbeit	K Arbeit	—	M Angabe	K Angabe	—
Szabados, M.	21	2	—	*1 292*	*245*	—
Szabó, E.	2	4	—	2	12	—
Szabó, I.	—	—	1	—	—	18
Szabó, M.	—	—	1	—	—	4
Szabolcs, I.	—	—	1	—	—	18
— Szalai, I.	1	1	—	131	37	—
Szemes, G.	21	1	—	*5 814*	*804*	—
Szentmihályi, S.	2	—	—	7	—	—
Szepes, I.	—	—	1	—	—	42
Székely, M.	—	—	1	—	—	99
Szépfalusi, J.	1	—	—	1	—	—
Takács, S.	—	—	5	—	—	295
Takáts, M.	—	—	1	—	—	26
Tamás, A.	—	—	1	—	—	100
Tamás, G.	38	2	1	*4 156*	*96*	233
200— Tangl H.	—	—	1	—	—	2
Tóth, L.	2	—	4	4	—	12
Tóth, S.	—	1	—	—	29	—
Tömösváry, Ö.	—	2	—	—	204	—
Török, P.	1	—	1	52	—	10
Uherkovich, G.	66	17	—	*6 433*	*2 000*	—
Urbányi, A.	—	—	1	—	—	161
Varga, I.	9	—	—	815	—	—
Varga, L.	18	7	4	*404*	*839*	362
Váncsa, A. L.	3	—	—	102	—	—
— Vásárhelyi, I.	—	—	1	—	—	67
Veszprémi, B.	4	—	—	56	—	30
Vigassy, J.	—	—	1	—	—	4
Vincze, K.	—	—	1	—	—	43
Vörös, L. Zs.	1	—	—	1	—	—
Wéber, M.	—	—	1	—	—	92
Wiesinger, K.	1	1	—	—	10	—
Woloszynska, J.	—	1	—	—	4	—
Zsicsi, A.	—	—	1	—	—	67
Zólyomi, B.	1	—	—	1	—	—
— Zsolt, J.	1	—	—	5	—	—
Insgesamt	727	374	—	43 492	18 626	—
220 Autoren	1101	Studien		62 118	Data	

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BROWALLIA SPECIES AS NEW HOSTS OF VARIOUS PLANT VIRUSES

By

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RESEARCH INSTITUTE FOR PLANT PROTECTION, BUDAPEST

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After a literary review of the virus susceptibility of the *Browallia* species (Family: *Solanaceae*) detailed data are found in our paper on the response of *Browallia demissa* L., *Browallia grandiflora* Grah. and *Browallia viscosa* H. B. et K. plants to viruses not studied so far. In the course of artificial infection experiments the *Browallia demissa* L. was found to react to infection by cherry leaf roll virus with systemic symptoms. It showed local and systemic susceptibility to five viruses (cucumber mosaic virus, potato aucuba mosaic virus, radish mosaic virus, tomato mosaic virus, tobacco ring spot virus), while proved resistant to further four viruses (bean [common] mosaic virus, potato virus M, potato virus S and turnip yellow mosaic virus). *Browallia grandiflora* Grah. and *Browallia viscosa* H. B. et K. displayed local and systemic susceptibility to eight viruses (cucumber mosaic virus, potato aucuba mosaic virus, potato virus X, potato virus Y, radish mosaic virus, tobacco mosaic virus, tomato mosaic virus and tobacco ring spot virus). The two latter plant species were found to be immune from infections by alfalfa mosaic virus, bean (common) mosaic virus, potato virus M, potato virus S and turnip yellow mosaic virus.

Two further *Browallia* species (*Browallia cordata* G. Don. and *Browallia roezli* Nichols) unknown so far in plant virology are locally and systemically susceptible to infections by cucumber mosaic virus, potato aucuba mosaic virus, potato virus X, radish mosaic virus, tobacco mosaic virus, tomato mosaic virus and tobacco ring spot virus. Both species proved to be immune from infections by alfalfa mosaic virus, bean (common) mosaic virus, potato virus M, potato virus S, potato virus Y, and turnip yellow mosaic virus. *Browallia roezli* Nichols is a new systemic host plant for cherry leaf roll virus.

Introduction

As seen from the papers published on the susceptibility of *Browallia* species to plant viruses responses of some seven species to 15 viruses are known at present (Table 1). According to the results of our earlier experiments performed with *Browallia* species, *Browallia demissa* L. is susceptible to infections by potato virus Y and potato virus X, and resistant to potato aucuba mosaic virus (cf. HORVÁTH 1968).

Our recent experiments are aimed at finding out how the *Browallia cordata* G.Don. and *Browallia roezli* Nichols species, unknown so far in plant virology, react to various viruses. We have studied some further *Browallia* host — virus relations too.

Table 1

Response of investigated Browallia species to plant viruses

Browallia species	Viruses		Literature
	Compatible	Incompatible	
	virus — *Browallia* host relationships		
Browallia americana L.	Tomato spotted wilt virus	—	Gardner et al. (1935)
	Tobacco mosaic virus	—	Holmes (1946)
	—	Tobacco etch virus	Holmes (1946)
Browallia demissa L.	Tobacco mosaic virus	—	Holmes (1946)
	Potato virus X	—	Horváth (1968)
	Potato virus Y	—	Horváth (1968)
	Alfalfa mosaic virus	—	Horváth and Beczner (1968)
Browallia elata L.	Potato virus X	—	Stelzner and Schwalb (1943), MacLeod (1962)
	Potato virus M	—	Bagnall et al. (1956)
	Potato virus Y	—	MacLeod (1962), Schmelzer and Wolf (1971)
	Potato aucuba mosaic virus	—	MacLeod (1962)
	Potato virus S	—	MacLeod (1962)
	—	Potato virus Y	Stelzner and Schwalb (1943), MacLeod (1962)
	—	Potato virus A	Stelzner and Schwalb (1943)
	—	Muskmelon mosaic virus	Rader et al. (1947)
Browallia grandiflora Grah.	Nasturtium ring spot virus	—	Schmelzer (1970)
Browallia speciosa Hook	Beet curly top virus	—	Freitag and Severin (1936)
	Potato virus X	—	Dennis (1939), Ladeburg et al. (1950)
	Cucumber mosaic virus	—	Price (1940)
	Tobacco etch virus	—	Holmes (1946)
	Tobacco mosaic virus	—	Holmes (1946)
	Beet mosaic virus	—	Bennett (1949), Schmelzer and Wolf (1971)
	Tomato spotted wilt virus	—	Smith (1957)
	Golden elderberry virus*	—	Hansen and Stace-Smith (1971)

* Serological relationships between golden elderberry virus and cherry leaf roll virus may exist.

Table 1 (continued)

Browallia species	Viruses		Literature
	Compatible	Incompatible	
	virus — *Browallia* host relationships		
Browallia viscosa H. B. et K.	Potato virus Y	—	Stelzner and Schwalb (1943)
	—	Potato virus X	Stelzner and Schwalb (1943)
	—	Potato virus Y	Stelzner and Schwalb (1943)
	Golden elderberry virus*	—	Hansen and Stace-Smith (1971)
	Nasturtium ring spot virus	—	Shukla and Schmelzer (1972)
Browallia zervaskiana (?)	—	Potato virus A	Stelzner and Schwalb (1943)
	—	Potato virus X	Stelzner and Schwalb (1943)
		Potato virus Y	Stelzner and Schwalb (1943)

Material and methods

Young *Browallia* plants were mechanically inoculated in the five and six leaf stage. All plants were grown from seeds in pots and kept in an aphid-free greenhouse. Two or three leaves of each plant were inoculated using carborundum powder (500 mesh) as an abrasive. The inoculated leaves were sprayed with destilled water after inoculations. The following viruses were used: strain *K2* of alfalfa mosaic virus, bean (common) mosaic virus, strain *YN* of cherry leaf roll virus (a newly isolated strain in Hungary), cucumber mosaic virus, potato aucuba mosaic virus, potato virus M, potato virus S, potato virus X, potato virus Y, radish mosaic virus, strain *U1* of tobacco mosaic virus, strain *H* of tomato mosaic virus (a newly isolated strain in Hungary), tobacco ring spot virus and turnip yellow mosaic virus. The pure viruses were kept in *Brassica rapa* L. var. rapa (radish mosaic virus, turnip yellow mosaic virus), *Nicotiana glutinosa* L. (potato aucuba mosaic virus), *Nicotiana tabacum* L. cv. Samsun (alfalfa mosaic virus, cucumber mosaic virus, potato virus X, potato virus Y, tobacco mosaic virus, tomato mosaic virus), *Nicotiana tabacum* L. cv. Xanthi-nc (tobacco ring spot virus, cherry leaf roll virus), *Phaseolus vulgaris* L. cv. Red Kidney (bean [common] mosaic virus), and *Solanum tuberosum* L. cv. Fortuna (potato virus S), as well as *Solanum tuberosum* L. cv. Bintje (potato virus M).

Symptoms on the inoculated *Browallia* plants were regularly registered. In addition to potato virus M and potato virus S infected plants were serologically investigated too. Serological investigations were carried out with plants about two or three weeks after inoculation. For serological tests the saps from the inoculated and non-inoculated leaves were clarified at approximately 6000 *rpm* for 15 minutes. Inoculated leaves of *Browallia* spp. were washed with tap water before any serological investigations. Serological tests were carried out by precipitin test. With the exception of potato virus M and potato virus S all viruses were reisolated from inoculated and non-inoculated leaves of *Browallia* spp. and tested on the following plant species: *Brassica rapa* L. var. *rapa* (radish mosaic virus, turnip yellow mosaic virus), *Chenopodium amaranticolor* Coste et Reyn. (cherry leaf roll virus), *Gomphrena globosa* L. (potato virus X), *Nicotiana glutinosa* L. (potato aucuba mosaic virus, tomato mosaic virus), *Nicotiana tabacum* L. cv. Samsun (alfalfa mosaic virus, potato virus Y), *Nicotiana tabacum* L. cv. Xanthi-nc (tobacco mosaic virus, tobacco ring spot virus), *Phaseolus vulgaris* L. (alfalfa mosaic virus), *Phaseolus vulgaris* L. cv. Red Kidney (bean [common] mosaic virus) and *Tetragonia expansa* Murr. (syn.: *Tetragonia tetragonoides* [Pall.] O. Ktze., cucumber mosaic virus). Inoculated *Browallia* leaves were washed with tap water before the reisolation of viruses. Before the reisolation of the investigated viruses, the expressed saps from the inoculated and non-inoculated leaves of infected *Browallia* plants were diluted 1 : 1 with tap water.

Data on the viruses included in our experiments can be found in detail in earlier papers (cf. Horváth 1973, 1974, 1974).

Fig. 1 Systemically infected *Browallia demissa* L. with tobacco mosaic virus (A), cherry leaf roll virus (B), and tobacco ring spot virus (C)

Table 2

*Reaction of Browallia species to various plant viruses**

Viruses	*Browallia* species		
	Br. demissa L.	*Br. grandiflora* Grah.	*Br. viscosa* H.B. et K.
Alfalfa mosaic virus	Susceptible (cf. HORVÁTH and BECZNER 1968)	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N
Bean (common) mosaic virus	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N
Cherry leaf roll virus	IL: no symptoms NIL: nec-sp, lem R: IL = N NIL = P	Not investigated	Not investigated
Cucumber mosaic virus	IL: chl-y-sp-led NIL: mo-lem R: IL = P NIL = P	IL: chl-y-sp-led NIL: mo-lem R: IL = P NIL = P	IL: chl-y-sp-led NIL: mo-lem R: IL = P NIL = P
Potato aucuba mosaic virus**	IL: no symptoms NIL: mo R: IL = P NIL = P	IL: no symptoms NIL: mo R: IL = P NIL = P	IL: no symptoms NIL: mo R: IL = P NIL = P
Potato virus M	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N	No susceptible*** R: IL = N NIL = N
Potato virus S	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N	No susceptible*** R: IL = N NIL = N
Potato virus X	Susceptible (cf. HORVÁTH 1968, HORVÁTH and BECZNER 1968)	IL: chl-sp NIL: no symptoms R: IL = P NIL = P	IL: no symptoms NIL: mo R: IL = P NIL = P
Potato virus Y	Susceptible (cf. HORVÁTH 1968, HORVÁTH and BECZNER 1968)	IL: no symptoms NIL: mo-sp R: IL = P NIL = P	Susceptible (cf. STELZNER and SCHWALB 1943)
Radish mosaic virus	IL: nec-sp-led NIL: chl-y-sp-lem R: IL = P NIL = P	IL: chl-nec-sp-led NIL: mo-lem-nec R: IL = P NIL = P	IL: chl-nec-sp-led NIL: mo-lem-nec R: IL = P NIL = P
Tobacco mosaic virus	Susceptible (cf. PRICE 1940)	IL: nec-sp-led NIL: nec-led R: IL = P NIL = P	IL: nec-sp-led NIL: nec-led R: IL = P NIL = P

* *Abbreviations:* chl, chlorotic; cori, concentric(al) rings; IL, inoculated leaves; led, leaf drop; lem, leaf malformation; mo, mosaic; N, negative; nec, necrotic; NIL, non inoculated or subsequently developed leaves; P, positive; R, reisolation of viruses; sp, spots; y, yellow.

** In our earlier investigations (cf. HORVÁTH 1968) *Browallia demissa* L. proved to be resistant to the English strain of potato aucuba mosaic virus. In our recent experiments the inoculations were carried out with the Hungarian strain of potato aucuba mosaic virus (PAMV-SS, HORVÁTH 1973), and the tested *Browallia demissa* L. was found to be locally (latent) and systemically (manifest symptom) susceptible.

*** Potato virus M and potato virus S were not reisolated from the inoculated *Browallia* plants, but were serological tested in the inoculated (IL) and non-inoculated (NIL) leaves of *Browallia* spp.

Table 2 (continued)

Viruses	*Browallia* species		
	Br. demissa L.	*Br. gradiflora* Grah.	*Br. viscosa* B. B. et K.
Tomato mosaic virus	IL: nec-sp-led NIL: mo-nec-led R: IL = P NIL = P	IL: nec-sp-led NIL: mo-nec-led R: IL = P NIL = P	IL: nec-sp-led NIL: mo-nec-led R: IL = P NIL = P
Tobacco ring spot virus	IL: nec-sp-cori NIL: nec-sp-cori	IL: nec-sp-cori NIL: nec-sp-cori	IL: nec-sp-cori NIL: nec-sp-cori
Turnip yellow mosaic virus	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N

Results and conclusions

In the course of our experiments the *Browallia demissa* L. plants were found to be systemically susceptible to one virus (cherry leaf roll virus), locally and systemically susceptible to five viruses (cucumber mosaic virus, potato aucuba mosaic virus, radish mosaic virus, tomato mosaic virus and tobacco ring spot virus; Fig. 1), while resistant to infections by further four viruses (bean [common] mosaic virus, potato virus M, potato virus S and turnip yellow mosaic virus; Table 2). When studying the responses of *Browallia grandiflora* Grah. we found it to be locally and systemically susceptible to eight viruses (cucumber mosaic virus, potato aucuba mosaic virus, potato virus X, potato virus Y, radish mosaic virus, tobacco mosaic virus, tomato mosaic virus and tobacco ring spot virus; Fig. 2), and resistant to infections by five viruses (alfalfa mosaic virus, bean [common] mosaic virus, potato virus M, potato virus S and turnip yellow mosaic virus; Table 2). *Browallia viscosa* H.B. et K. proved to be a local and systemic host plant of seven viruses (cucumber mosaic virus, potato aucuba mosaic virus, potato virus X, radish mosaic virus, tobacco mosaic virus, tomato mosaic virus, tobacco ring spot virus), and resistant to five viruses (alfalfa mosaic virus, bean [common] mosaic virus, potato virus M, potato virus S; Fig. 3).

Two virus-diagnostically new plant species — *Browallia cordata* G.Don. and *Browallia roezli* Nichols — showed local and systemic susceptibility to infections by seven viruses (cucumber mosaic virus, potato aucuba mosaic virus, potato virus X, radish mosaic virus, tobacco mosaic virus, tomato mosaic virus and tobacco ring spot virus; Fig. 4 and Fig. 5). The above two plant species displayed a resistance to infections by alfalfa mosaic virus, bean (common) mosaic virus, potato virus M, potato virus S, potato virus Y and turnip yellow mosaic virus. *Browallia roezli* Nichols plants inoculated with cherry leaf roll virus were systemically susceptible to virus infection (Table 3).

Table 3

*Browallia species as new hosts of various plant viruses**

Viruses	*Browallia* species	
	Br. cordata G. Don	*Br. roezli* Nichols
Alfalfa mosaic virus	No symptoms R: IL = N NIL = N	No symptoms R: IL = N NIL = N
Bean (common) mosaic virus	No symptoms R: IL = N NIL = N	No symptoms R: IL = N NIL = N
Cherry leaf roll virus	Not investigated	IL: no symptoms NIL: nec-sp-lem R: IL = N NIL = P
Cucumber mosaic virus	IL: no symptoms NIL: mo R: IL = P NIL = P	IL: no symptoms NIL: mo R: IL = P NIL = P
Potato aucuba mosaic virus	No symptoms R: IL = P NIL = P	No symptoms R: IL = P NIL = P
Potato virus M	No symptoms R: IL = N NIL = N	No symptoms R: IL = N NIL = N
Potato virus S	No symptoms R: IL = N NIL = N	No symptoms R : IL = N NIL = N
Potato virus X	IL: no symptoms NIL: mo R: IL = P NIL = P	IL: no symptoms NIL: mo R: IL = P NIL = P
Potato virus Y	No symptoms R: IL = N NIL = N	No symptoms R: IL = N NIL = N
Radish mosaic virus	IL: chl-nec-sp-led NIL: mo-lem-nec R: IL = P NIL = P	IL: chl-nec-sp-led NIL: mo-lem-nec R: IL = P NIL = P
Tobacco mosaic virus	IL: nec-sp-led NIL: nec-led R: IL = P NIL = P	IL: nec-sp-led NIL: nec-led R: IL = P NIL = P
Tomato mosaic virus	IL: nec-sp-led NIL: mo-nec-led R: IL = P NIL = P	IL: nec-sp-led NIL: mo-nec-led R: IL = P NIL = P
Tobacco ring spot virus	IL: nec-sp-cori NIL: nec-sp-cori R: IL = P NIL = P	IL: nec-sp-cori NIL: nec-sp-cori R: IL = P NIL = P
Turnip yellow mosaic virus	No susceptible R: IL = N NIL = N	No susceptible R: IL = N NIL = N

* Abbreviations see in Table 2.

Fig. 2 Symptoms on *Browallia grandiflora* Grah.after mechanical inoculation with four different plant viruses. A: Cucumber mosaic virus, B: Tobacco mosaic virus, C: Turnip yellow mosaic virus (left: two immune plants) and radish mosaic virus (right: two susceptible plants)

Our experiments concerning the *Browallia* host — virus relations greatly contributed to the knowledge of the responses given by the individual species to virus infections. *Browallia demissa* L. — with the present results of experiments also taken into consideration — is susceptible to a total of 10 viruses or so; the present paper points out its susceptibility to six viruses.

Browallia grandiflora Grah. — which has been known so far to be only susceptible to a single virus (nasturtium ring spot virus, cf. SCHMELZER 1970) — in our recent experiment has proved susceptible to further eight plant viruses. We added seven viruses to the earlier two to which *Browallia viscosa* H.B. et K. had been found to be susceptible (see Table 1). Besides pointing out new host-virus relations our experiment data call attention to *Browallia* species immune from various viruses, which can play an important role in isolating certain viruses.

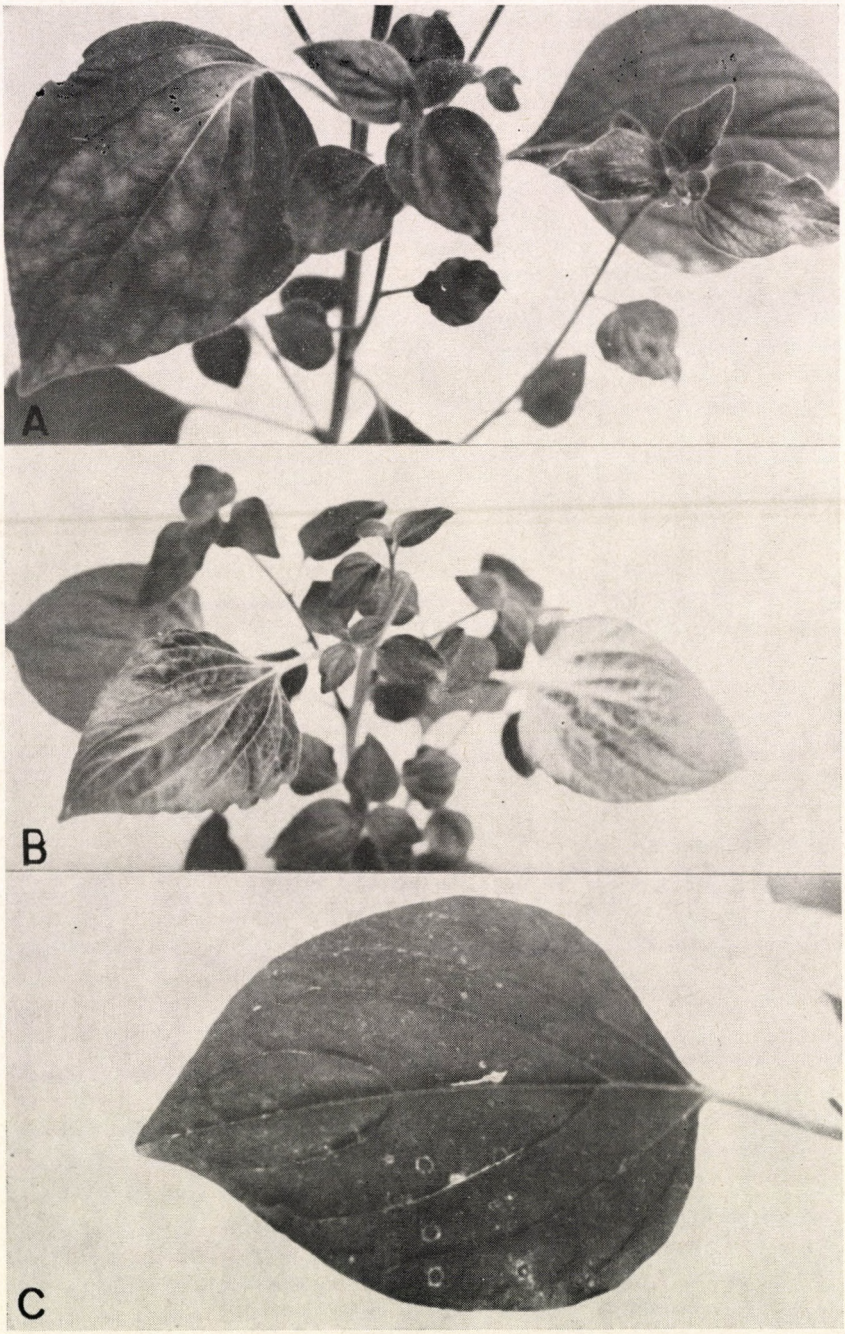

Fig. 3 Symptoms on *Browallia viscosa* H. B. et K. plants. A: Radish mosaic virus, B: Cucumber mosaic virus, C: Tobacco ring spot virus

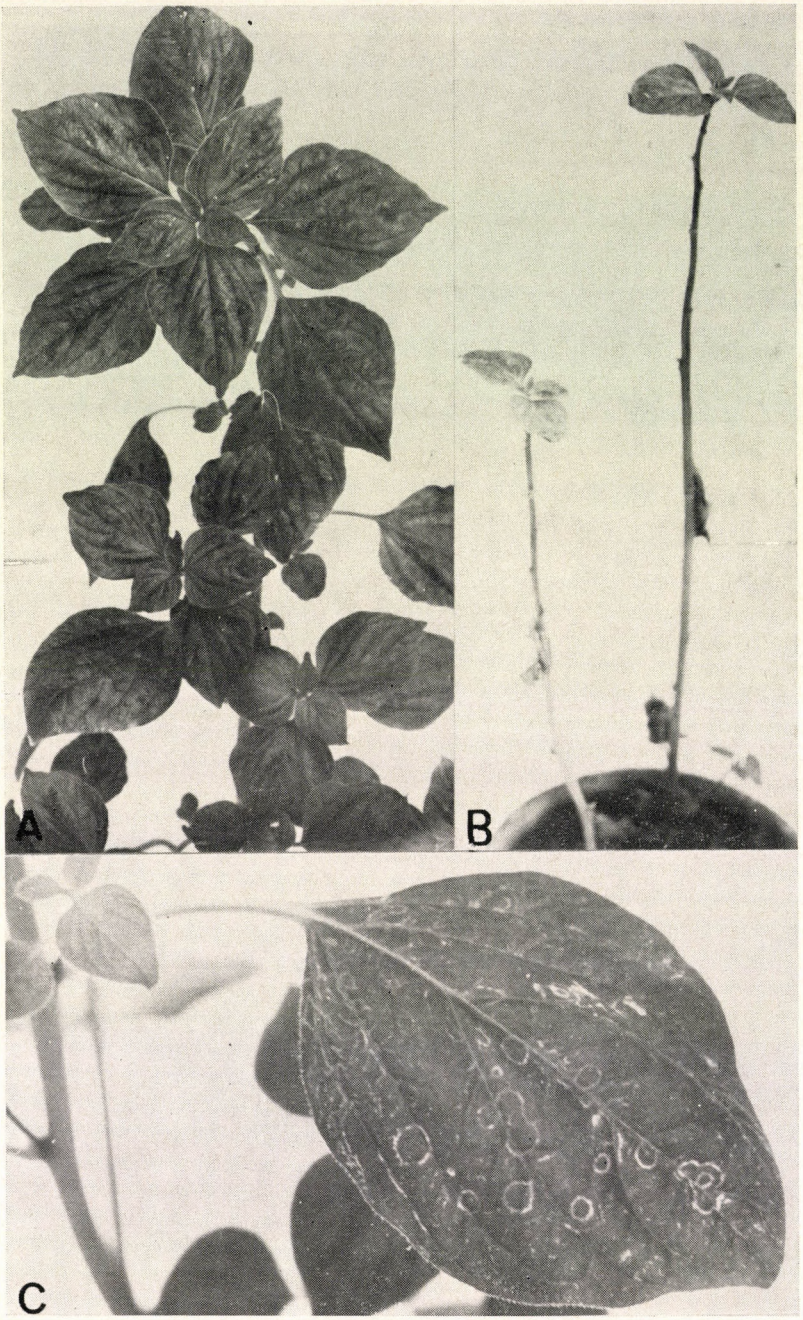

Fig. 4 Symptoms induced by three plant viruses on *Browallia cordata* G. Don. A: Radish mosaic virus, B: Tobacco mosaic virus, C: Tobacco ring spot virus

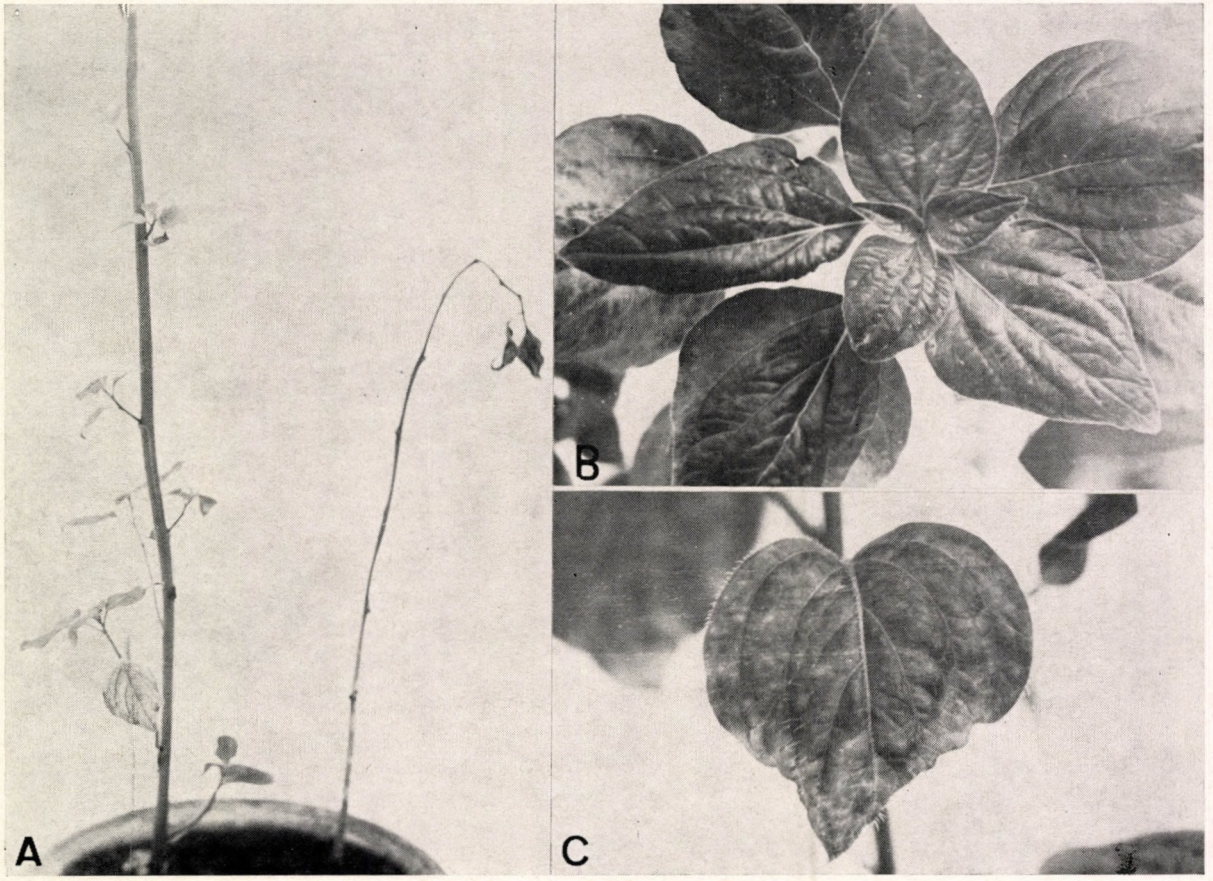

Fig. 5 Symptoms on *Browallia roezli* Nichols plants. A: Tobacco mosaic virus, B: Cucumber mosaic virus, C: Radish mosaic virus

The species *Browallia cordata* G. Don. and *Browallia roezli* Nichols are particularly important, because — as far as we know — their virus susceptibility was first demonstrated in our present experiments. In the course of our experiments we have pointed out numerous possibilities of further host — virus relations which may be of importance not only in identifying but also in separating the plant viruses.

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PRODUCTION INVESTIGATIONS OF THE UNDERGROWTH (HERBACEOUS LAYER) OF A QUERCETUM PETRAEAE = CERRIS FOREST ECOSYSTEM*

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The paper deals with the production relations in the undergrowth (herbaceous layer) of the climate — zonal *Quercetum petraeae-cerris* forest ecosystem within the "Síkfőkút Project" biosphere research. The results relate to the year 1973. After describing survey methods individual numbers per herbaceous species and their estimated cover values related to hectare are given. Monthly changes in phytomass weight, in a break-down of aboveground, living and dead, as well as belowground fractions are described. Turnover rate and time, root importance index and the parameters related to productivity are discussed.

One of the bases of Hungarian ecosystem examinations carried out within the framework of the international MAB programme is the interdisciplinary research into the subcontinental colline climate-zonal oak-forest (*Quercetum petraeae-cerris*). For the description of the multiannual complex research project, and for the environment-ecological as well as phytocenological descriptions of the sampling area set up in the interception zone between the Northern Hungarian Central Range and the Hungarian Plain (Síkfőkút Project, near Eger) see JAKUCS' paper (1973). In their starting phase, investigations into the functioning of the autoregulatory ecosystem, circulations and energy fluctuations of mineral factors (bringing about its state of equilibrium), etc. proposed to obtain an answer related to the complete phytocenological structure, phytomass and to the pattern of primary production. Within this framework, the most important data, relating to the foliage and shrub layers, are included in the papers by JAKUCS—HORVÁTH—KÁRÁSZ (1975,) and PAPP (1975,). The present paper deals with the 1973 production of forest undergrowth (herbaceous layer), and also with the individual and coverage conditions of the species in question.

Structure data and survey

It is in general characteristic of the undergrowth of the xeromesophyllous deciduous *Quercetum petraeae-cerris* forest that — owing to the mosaic-like light-shade conditions deriving from the measure of closing of the canopy and shrub layers, the herbaceous layer exhibits

* "Síkfőkút Project" No. 12.

a correspondingly disperse appearance. An increased radiation reaching the ground surface is favourable for the mass cespitose appearance of certain grass and heliophilous species, while a reduced radiation due to more intensive shade is rather favourable for the more umbrophilous species growing individually. Because of the mosaic-like disperse appearance of the undergrowth species, we used the method described below in order to obtain the specimen and cover values necessary for the calculation of phytomass and production conditions per hectare.

A 50×50 m quarter of the central basic hectares of the sample area was subdivided with nylon twine into small squares of 4×4 m (16 m^2). In 73 of the 144 small squares (in alternating order) we took individual counts per species and estimated their cover values within the squares (and also expressed them in m^2). The data of the 73 small squares were complemented with the similarly obtained data of an additional 10 squares (of 4×4 m^2) randomly chosen in other parts of the forest. Thus the accurate number of individuals, and their cover, related to a 83×16 cm^2 area (1328 m^2), could be taken as a basis for conversion into hectares. It is to be noted that counting by the individuals in the two dominant grasses (*Poa nemoralis*, *Melica uniflora*) was almost impossible in practice, therefore, in the case of these two species, we counted the exact numbers of individuals in 30 squares of randomly taken 4 dm^2 areas for each species (averages: in *Poa nemoralis* 71, in *Melica uniflora* 34 individuals). The values thus obtained were multiplied by their total cover values within the hectare and so their individual data were obtained.

From the values given in Table 1 it can be seen that the total cover of the undergrowth in the forest is 24.98%, and the number of individuals is 1,428,510 ($\pm 5\%$). On the basis of specimen numbers and the cover percentages, the following species can be considered most frequent: *Poa nemoralis*, *Melica uniflora*, *Carex michelii*, *C. montana*, *Galium schultesii*, *Dactylis polygama*, *Chrysanthemum corymbosum*, *Festuca heterophylla*, *Fragaria vesca*, *Lathyrus niger*, *L. vernus*. In the row "other" of the Table, the following relatively more frequent species appear n addition: *Brachypodium silvaticum*, *Carex digitata*, *Calamintha officinalis*, *Dictamnus albus*, *Iris variegata*, *I. graminea*, *Melittis grandiflora*, *Viola hirta*, *Vicia cassubica*, etc.

Table 1

Number of individual plants and estimated cover data of the undergrowth in the forest on 1328 m^2, and their conversion to ha

	1 328 m^2		10 000 m^2	
	specimens	cover m^2	specimens	cover per cent
Carex michelii	11 952	66.16	90 000	4.981
Carex montana	6 957	32.48	52 387	2.446
Chrysanthemum corymbosum	11	0.96	83	0.072
Dactylis polygama	2 207	36.80	16 618	2.771
Festuca heterophylla	2 174	8.16	16 377	0.615
Fragaria vesca	253	7.44	1 905	0.554
Galium schultesii	648	42.56	5 150	3.205
Lathyrus niger	99	7.60	746	0.572
Lathyrus vernus	19	2.56	143	0.193
Melica uniflora	32 290	38.00	243 112	2.861
Poa nemoralis	130 490	73.52	982 665	5.536
Other	2 566	15.52	19 325	1.169
	189 702	30.18	1 428 510	24.975

Investigation methods applied in production survey

In order to estimate the production data of the undergrowth in the forest, 10 species, the largest in individual number and cover (dominant species), were examined (for their enumeration see Table 2). On the basis of an estimation other species besides these, increase the value of undergrowth phytomass by 5—6% at the most. This increase can, on the other hand, be said to be relatively standard throughout the year; in spring mainly the geophytes, in summer certain grass species and dicotyledons contribute to it.

We applied two types of sampling for the establishment of the annual changes in the organic matter. From the densely growing but loose-hosted *Poa nemoralis* and *Melica uniflora* grasses (unmixed with other species) in certain parts of the forest, the dead and living phytomass of 5 plots measuring 20×20 cm each was cut with the so-called harvest method (ODUM 1960), generally used in sampling grass associations. The two fractions gathered aboveground were immediately separated in sacs. Their underground parts were taken out, together with the soil, by monolith collectors of $20 \times 20 \times 10$ cm, then were transpored in bags to the laboratory for washing.

In the case of every other plant the individual plant method was applied.*

At a time of sampling we lifted with spade 30 individuals per each species, at depths corresponding to their specific characteristics. The aboveground fractions and the underground parts were separated according to species. In the laboratory the soil was removed of the underground parts, in both sampling types, by washing them several times through 1 mm gauge sieves; root parts of other species possibly mixed with the sampled species were removed from the monoliths. No unambiguous rapid method for the separation of living and dead parts from the underground phytomass is known in literature; we also treated these two fractions together.

It should be noted that in the case of *Fragaria vesca*, which spreads by runners plants already possessing roots of their own were considered independent individuals.

The collected fractions underwent drying at 85 °C, for 48 hours.** The weighed quantity of the material collected per individuals, and calculated for one individual, was multiplied by the number of specimens in a hectare, while

* Sampling by individuals is not a frequent method in ecosystem investigations (although it is suggested by MILNER—HUGHES 1968, NEWBOULD 1970, and others). However, in our opinion, working in decideous forest ecosystems only with the harvest method implies possibilities of errors due to the characteristic appearance of the underwood.

** We employed desiccation at 85 °C because the collected sample was measured also for mineral and energy contents; according to certain authors (DUVIGNEAUD-DENAEYER—DE SMET 1970, ANDERSON 1971) materials, after having been dried at 105 °C, give less reliable results.

Table 2

Monthly dry-weight data of the fractions of phytomass/ha

	A	B	C	D	E
III. a	1 620.00	2 619.35	—	531.78	62.87
III. b	7 740.00	12 677.65	—	2 293.28	137.16
III. c	33 210.00	43 009.73	—	7 129.12	384.81
III. d	42 570.00	58 306.73	—	9 954.18	584.84
IV. a	13 050.00	3 771.86	20.75	781.05	415.29
IV. b	6 030.00	9 115.34	1.66	2 409.61	100.97
IV. c	36 360.00	27 765.11	150.40	13 759.70	503.92
IV. d	55 440.00	40 652.31	172.81	16 950.36	1 019.18
V. a	13 590.00	6 286.44	35*t*19	1 429.15	872.49
V. b	7 920.00	9.272.50	1.74	2.725.35	179.07
V. c	19 530.00	33 946.78	241.12	5 716.59	708.66
V. d	41 040.00	49 505.72	278.05	9 871.09	1 760.22
VI. a	13 320.00	5.081.54	41.83	2.044.01	539.12
VI. b	8 370.00	5 448.25	2.08	2 044.01	222.89
VI. c	24 030.00	21 164.35	113.05	6.680.44	754.38
VI. d	45 720.00	31 694.14	156.96	10 768.46	1 516.39
VII. a	16 200.00	4 190.96	38.84	2 077.25	601.98
VII. b	6 390.00	2 933.67	6.89	2.775.21	274.32
VII. c	20 970.00	18 021.13	153.72	4 270.83	674.37
VII. d	43 560.00	25 145.76	199.45	9.123.29	1 550.67
VIII. a	10 710.00	4 086.19	46.48	2 459.46	588.65
VIII. b	7 020.00	942.97	5.98	2*t*825.06	110.49
VIII. c	33 840.00	28 027.05	133.05	8 342.24	782.96
VIII. d	51 570.00	33 056.21	185.51	13 626.76	1 482.10
IX. a	8 010.00	3 405.16	29.38	1 462.38	556.26
IX. b	6 300.00	2 095.48	14.53	1 545.47	224.79
IX. c	26 550.00	22.631.18	125.75	6.879.85	674.37
IX. d	40 860.00	28 131.82	168.66	9 887.71	1 455.42
X. a	15 930.00	3 247.99	26.23	1 994.16	594.36
X. b	15 300.00	5 133.93	31.29	5 882.77	291.47
X. c	29 250.00	16 921.00	132.22	6 929.71	756.29
X. d	60 480.00	25 302.92	189.74	14 806.64	1 642.12

of the undergrowth, broken down to species. g/ha

F	G	H	I	J	K
—	—	—	414.91	4 041.38	9 290.29
—	—	—	18 542.13	19 210.41	60 600.63
—	—	—	45 290.60	42 642.12	171 672.38
—	—	—	64 253.64	65 893.91	241 563.30
288.40	50.66	36.47	6 438.24	27 542.30	52 395.02
—	—	4.15	16 610.66	26 130.58	60 402.97
824.00	425.40	158.30	61 070.28	143 524.43	284 540.54
1 112.40	476.06	198.91	84 119.18	197 197.31	397 338.53
1 318.40	230.21	71.93	16 925.42	44 815.05	85 574.28
56.65	—	2.43	8 026.34	41 188.88	69 372.96
1 009.40	517.78	175.32	71 521.69	117 476.89	250 844.23
2 384.45	747. 98	249.68	96 473.45	203 480.83	405 791.47
1 071.20	252.56	58.77	22 161.85	52 731.73	97 302.61
25.75	—	—	18 699.51	42 323.79	77 136.28
1 447.15	657.84	208.78	66 836.09	102 778.44	224 670.52
2 544.10	910.40	267.55	107 697.45	197 833.96	399 109.41
1 673.75	411.99	67.64	33 836.53	71 720.69	130 819.63
66.95	—	2.57	18 370.45	63 554.89	94 374.95
1 339.00	788.21	263.55	65 398.21	110 183.03	222 062.05
3 079.70	1 200.20	333.76	117 605.19	245 458.61	447 256.63
1 194.80	352.39	77.51	19 085.81	67 596.27	106 197.56
185.40	—	4.58	11 460.07	54 890.83	77 445.38
1 135.45	1 823.76	194.77	45 518.36	116 549.59	236 566.23
2 734.65	2 176.15	276.86	76 064.24	239 036.69	420 209.17
540.75	377.72	66.21	16.868.19	47 666.17	78 982.22
113.30	4.47	0.57	14 807.95	44 067.67	69 174.23
1 287.50	2 572.49	124.98	49 438.53	76 232.65	186 516.30
1 941.55	2 954.68	191.76	81 114.67	167 966.49	334 672.75
535.60	346.43	57.20	17 583.55	33 438.28	73 753.80
133.90	84.93	8.44	21 560.95	49 908.30	98 335.98
1 787.05	1 995.86	236.67	55 311.64	64 385.31	177 705.75
2 456.55	2 427.22	302.31	94 456.14	147.731,89	349 795.53

Table 2

	A	B	C	D	E
XI. a	6 480.00	261.94	16.85	1 445.77	360.05
XI. b	19 260.00	5 972.12	21.26	6 481.02	213.36
XI. c	17 550.00	10 948.88	100.85	4 021.56	955.84
XI. d	43 290.00	17 182.94	138.95	11 948.35	1 539.25

A *Carex michelii*
B. *Carex montana*
C *Chrysanthemum corymbosum*
D *Dactylis polygama*
E *Fragaria vesca*
F *Galium schultesii*
G *Lathyrus niger*
H *Lathyrus vernus*
I *Melica uniflora*
J *Poa nemoralis*
K Σ

in the case of the harvested monolith material (4 dm^2 or 4 dm^3), it was calculated for the average weight of the 5 samples each, and was multiplied by the data of total cover.

Results and discussion

Net primary production

The monthly course of change in the phytomass and its fractions calculated for 1 hectare is shown in Table 2 and Fig. 1. The maximum production of the undergrowth in the forest ecosystem appeared in July (447.27 kg/ha; with the correction of the other species 469.69 kg/ha). For comparison, one might mention that in the *Querco petraeae — Carpinetum* mesophyllous forest ecosystem of the Czechoslovakian "BAB-Project" a maximum of 447 kg/ha appeared in September (KUBIČEK-BRECHTL 1970, SIMONOVIČ 1973).

The maximum of the aboveground living phytomass (131 kg/ha), and also the second maximum of the dead fraction (94 kg/ha) again appeared in July; the latter attained its maximum (104 kg/ha) in October after a transitional decrease at the end of summer. The first powerful increase in the underground phytomass (284 kg/ha) ended in April, this served, as it were, as a basis for the more powerful increase in the aboveground parts, which started to grow at that time, for the producing of flower and fruit; but in addition a lower second maximum (236 kg/ha) also appeared by the end of summer.

The 1973 phytomass fraction patterns of four selected test plants (*Carex montana*, *C. michelii*, *Melica uniflora*, *Poa nemoralis*) are also shown graphically (Fig. 2).

The turnover rate and turnover time provide information on the turnover in phytomass fractions (DAHLMAN-KUČERA 1965, ODUM 1960, PRÉCSÉNYI

(continued)

F	G	H	I	J	K
458.35	—	50.48	5 594.12	43 873.91	58 541.47
159.65	—	10.15	21 589.57	50 378.87	104 085.99
1 138.15	—	220.65	49 066.54	58 129.47	142 141.94
1 756.15	—	281.28	76 250.23	152 382.25	304 769.40

a. aboveground living phytomass fraction
b. aboveground dead phytomass fraction
c. underground phytomass
d. aboveground + underground phytomass

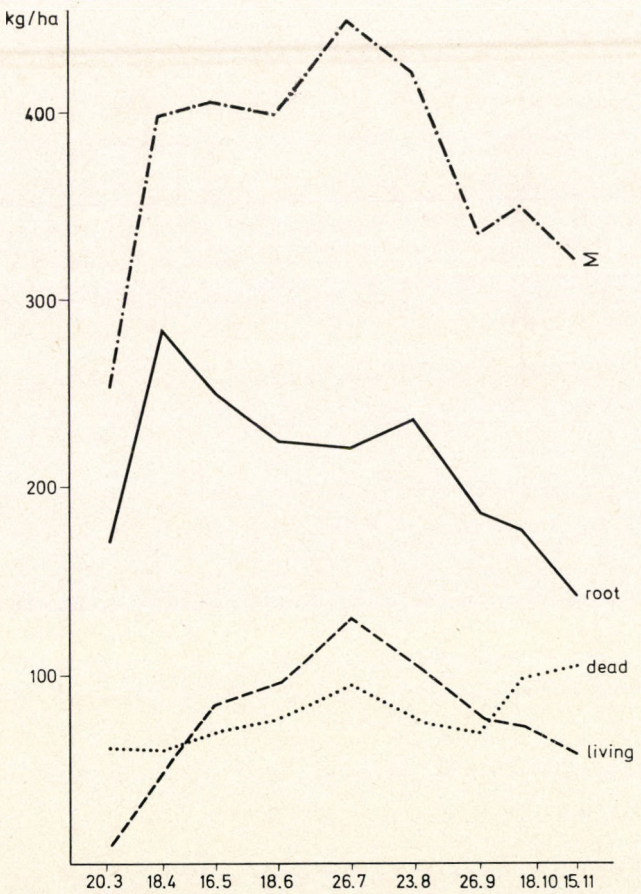

Fig. 1 Changes in the phytomass of the herbaceous layer and in the dry weight of the phytomass fractions during the vegetation period (kg/ha)

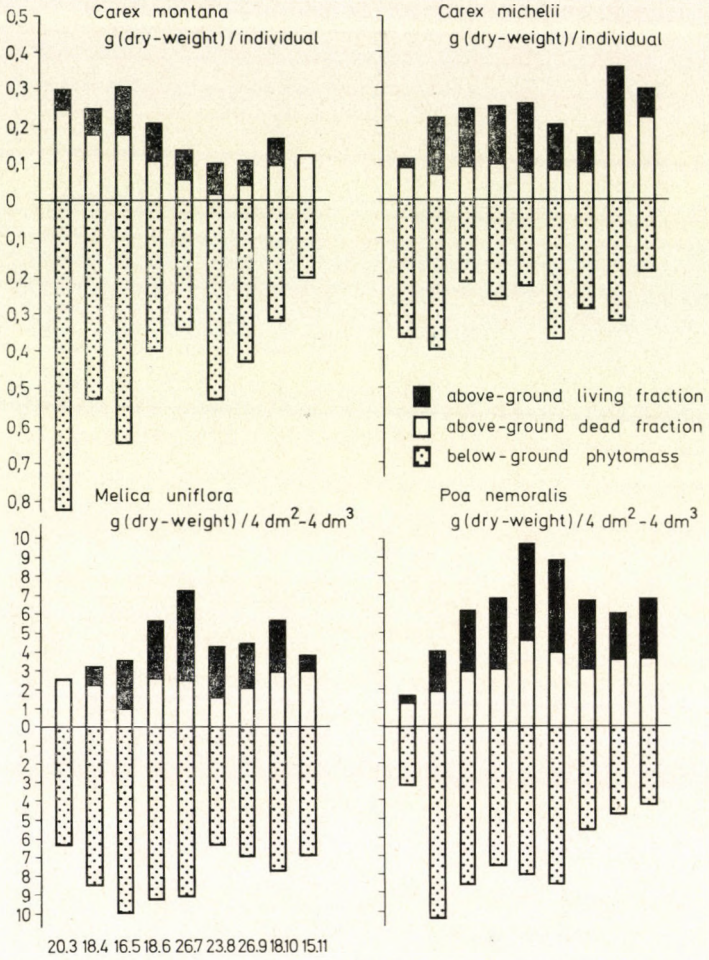

Fig. 2 Changes in the phytomass fractions in case of the four tested species

1972 etc.; Table 3). The turnover rate of the aboveground parts of the herbaceous undergrowth in the forest examined is very high; indicating a rapid turnover in them. The high value is substantiated also by the observation that it is only certain aboveground parts of *Fragaria vesca*, *Carex michelii* and *Poa nemoralis* which survive in their living (green) state during the winter months. The turnover rate of the standing dead parts is of 80.2%. This value indicates that this fraction shows, in comparison with the living parts, a relative stability throughout the year. This can be explained by the presence of grasses and sedges sharing in the undergrowth production in a decisive proportion; their dead parts mostly remain standing throughout even the winter.

Table 3

Turnover rate and time of the fractions of undergrowth and the specially investigated 4 species

	Turnover rate (per cent)			Turnover time (month)		
	aboveground		underground	aboveground		underground
	living	dead		living	dead	
Total undergrowth	95.4	80.2	61.2	13.1	14.9	19.6
Carex michelii	90.0	67.3	—	13.3	17.8	—
Carex montana	95.8	92.5	—	12.5	13.0	—
Melica uniflora	98.8	62.8	—	12.0	19.0	—
Poa nemoralis	94.4	69.7	—	12.7	17.2	—

The turnover rate of root is 61.2%, the turnover time is 19.6 months. For a comparison, we present the turnover rates of the undergrowth in the alkali forest steppe-forest (*Galatello-Quercetum poëtosum nemoralis*) in the Great Hungarian Plain: aboveground living parts = 68%, forest litter = = 81%, root = 58% (PRÉCSÉNYI 1971).

The ratio of the underground (B) and aboveground parts (A) changes throughout the vegetation period (Table 4). The values obtained are considerably lower in the undergrowth of the *Quercetum petraeae-cerris* forest than in

Table 4

Development of RII per cent (root-importance index) and B/A (dry-weight of B = underground, A = aboveground phytomass fraction) ratio during the growth period

	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
RII%	71.06	71.61	61.81	56.29	49.64	56.29	55.73	50.86	46.66
B/A	2.46	2.52	1.62	1.29	0.99	1.29	1.26	1.03	0.87

the case of the arid grass associations in Hungary (PRÉCSÉNYI 1969, KOVÁCS-LÁNG and SZABÓ 1971). This is in agreement with the former statement, namely that the root — stem ratio increases with the increase in the xerotermous character (BRAY 1963, STRUIK-BRAY 1970). The root phytomass decreases only in July, at the time of peak production, and in November, slightly below the weight of the aboveground parts. The B/A ratio related to the whole year is 1.351 : 1. This ratio is 1.219 : 1, on the basis of measurements by SIMONOVIČ (1973) in the Slovakian hornbeam-oak forests.

The root importance index (RII%), expressesing the ratio between the aboveground parts and the total phytomass (MÁTHÉ — PRÉCSÉNYI — ZÓ-

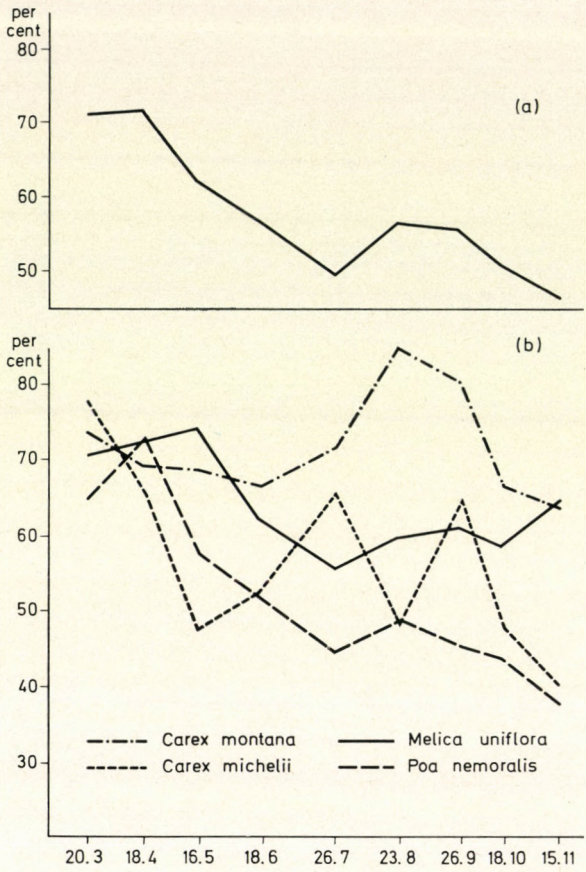

Fig. 3 Changes in the root importance index of the herbaceous Layer (A) and the four dominant species (B) during the vegetation period (1973)

LYOMI 1967) runs to a certain extent parallel with the B/A ratio (Table 4, Fig. 3). The values vary between 46.66% and 71.61%. The curve calculated for the whole undergrowth layer as well as the curve of *Poa nemoralis*, take a decreasing trend from the beginning to the end of the growth period; they show a smaller increase only in August. The saliently high B/A ratio of *Carex montana* in August-September, and the RII% running parallel with this, indicate a strong early-summer growth, then a rapid destruction of the aboveground parts of the plant (this fact has been confirmed also by phenological studies).

Productivity

The production balance of the aboveground phytomass (the changes in weight between the individual samples) showed positive values up to July (Table 5.) Subsequently, it indicated a negative value, with the exception of

Table 5

Production balance (g/m^2) of the phytomass fractions of the undergrowth

	Aboveground fractions			Underground fraction
	living	dead	Σ	
III.—IV.	+4.3105	−0.0198	+4.2907	+11.2868
IV.—V.	+3.3179	+0.8970	+4.2149	− 3.3696
V.—VI.	+1.1728	+0.7763	+1.9492	− 2.6174
VI.—VII.	+3.3517	+1.7239	+5.0756	− 0.2609
VII.—VIII.	−2.4622	−1.6930	−4.1552	+ 1.5505
VIII.—IX.	−2.7215	−0.8271	−3.5487	− 5.0050
IX.—X.	−0.5228	+2.9162	+2.3933	− 0.8811
X.—XI.	−1.5212	+0.5750	−0.9462	− 3.5564
III.—XI.	+4.9251	+4.3485	+9.2737	− 2.9530

Table 6

Productivity of the phytomass fractions ($g/m^2/day$)

	Aboveground fractions			Underground fraction
	living	dead	Σ	
III.—IV. 29	+0.1486	−0.0007	+0.1480	+0.3892
IV.—V. 28	+0.1185	+0.0320	+0.1505	−0.1203
V.—VI. 33	+0.0355	+0.0235	+0.0591	−0.0793
VI.—VII. 38	+0.0882	+0.0454	+0.1336	−0.0069
VII.—VIII. 34	−0.0724	−0.0498	−0.1222	+0.0427
VIII.—IX. 34	−0.0800	−0.0243	−0.1044	−0.1472
IX.—X. 22	−0.0238	+0.1326	+0.1088	−0.0400
X.—XI. 28	−0.0543	+0.0205	−0.0338	−0.1270
Variation	0.1985	0.1823	0.2727	0.5364

the positive value between September and October. In relation to the whole growth period, a positive value was obtained. Within the aboveground phytomass, the living fraction shows a positive weight increase up to July; then it

becomes negative up to the end. On the other hand, the weight balances of the dead fraction show positive values also during the spring and the autumn. A decrease in weight occurs only in July-August and August-September. After the earlyspring maximum the underground remains negative — with the exception of the positive value between July and August — up to the end of the year.

The productivity values expressing the increases and decreases in weight per day and surface unit are in the aboveground parts (Table 6) positive up to July, then they become negative. The productivity values of the aboveground dead parts show the course of yearly change well (spring and autumn positive values). The highest positive value occurs between September and October, indicating that the dying process is most intensive during that time.The underground phytomass presents negative values throughout, with the exception of a late summer and a significant earlyspring value. The daily production related to the whole growth period (246 days) is indicated by the following values:

living (green) aboveground parts:	+ 0.0200 g/m²/day
dead aboveground parts:	+ 0.0177 g/m²/day
underground phytomass:	— 0.0120 g/m²/day

The ratio of increase or decrease per day, and its calculated percentage (relative growth ratio; BRODY 1945) is given in Table 7. It can be seen that the daily weight increase in the living aboveground parts in March-April was almost of 6%, and it surpassed the 1% value even during the following month. A 3% negative peak in September also occurred. The relative daily growth percentage of the underground matter and of the dead aboveground parts per surface unit remained in general below 1%.

Summary

Within the "Síkfőkút Project" biosphere research the paper deals with the structure and production relations of the herbaceous undergrowth of the *Quercetum petraeae-cerris* climate-zonal forest ecosystem. The results relate to 1973.

The cover of the undergrowth of the forest is 24.98%, the number of individuals per 1 ha is 1, 428, 510. The production maximum of the undergrowth is in July (469.62 kg/ha). Of this, the aboveground living phytomass is 29.25%, the aboveground dead matter is 21.10%, the underground root phytomass is 49.65%. The major part of production throughout the growth period is ascribable to the following four species: *Poa nemoralis* (25.97—54.18%,

Table 7

Relative growth ratio (RGR) of the phytomass fractions of the undergrowth

	Aboveground fractions		Underground fraction
	living	dead	
III.–IV. 29	+0.060	−0.001	+0.017
IV.–V. 28	+0.018	+0.005	−0.005
V.–VI. 33	+0.004	+0.003	−0.003
VI.–VII. 38	+0.008	+0.005	0.000
VII.–VIII. 34	−0.006	−0.006	+0.002
VIII.–IX. 34	−0.009	−0.003	−0.007
IX.–X. 22	−0.031	+0.016	−0.002
X.–XI. 28	−0.008	+0.002	−0.008
III.–XI. 246	+0.007	+0.002	−0.001

Melica uniflora (17.24—25.72%), *Carex montana* (5.35–22.98%), *Carex michelii* (9.28–16.73%).

The aboveground living phytomass presents the highest value in July, after a vigorous growing process in spring. The quantity of the standing dead fractions increase considerably by the autumn months. The weight of the underground phytomass is, on the other hand, greatest during the early spring.

The turnover rate of the aboveground phytobiomass is high (95.4%), that of the dead fraction is only 80.2%, owing to the presence of dominant grasses and sedges. The turnover percentage of the underground phytomass is 61.2%; the root importance index (RII%) varies between 46.66 and 71.61%.

The productivity values of the aboveground fractions related to the whole growth period are positive, those of the underground phytomass negative.

By analysing the data of *Carex montana*, *C. michelii*, *Melica uniflora* and of *Poa nemoralis* also separately, it can be stated that on the basis of the production pattern no parallel can be drawn between the two *Carex* species. The changes in the aboveground fractions of *Poa nemoralis* and *Melica uniflora* show some similarity.

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EXAMINATION OF DYNAMICS OF ORGANIC MATTER IN A PERENNIAL OPEN SANDY STEPPE-MEADOW (FESTUCETUM VAGINATAE DANUBIALE) AT THE CSÉVHARASZT IBP SAMPLE AREA (HUNGARY)

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The changes of phytomass fractions and soil organic matter were examined during the growing season (April-October), in 1971, on the basis of monthly sampling in a perennial open sandy grassland — *Festucetum vaginatae danubiale* — characteristic to the sandy regions of the Great Hungarian Plain.

The phytomass was estimated on 22 monoliths of a size of $20 \times 20 \times 20$ cm each, taken monthly. The plant material of the samples was separated into the following parts: aboveground living phanerogamous parts, dead phanerogamous parts, cryptogams and underground plant parts (roots). The phytomass fractions were weighed in air-dry condition. The amount of humus substances accumulated within the monoliths was determined by wet oxidation.

On the basis of phytomass measurements productivity, ecological efficiency and turnover were estimated. For the evaluation of data statistical methods were used.

Within the total organic matter of the monolith samples representing the studied plant-soil system, the soil organic materials were predominant, accounting for about 50 per cent of the total. The proportion of phytomass fractions to the total was the following: roots about 35 per cent, aboveground living floral parts 1—2 per cent, dead floral parts 6—10 per cent, cryptogams 3—6 per cent, respectively.

As compared with the results of the investigations in 1968, it can be established that in the extremely dry year of 1971 the amount of roots and living floral parts decreased with the parallel increase of the dead floral parts.

The loss of phytomass productivity, ecological efficiency and turnover rate in 1971 shows the decrease of the intensity of the metabolic processes within the system. On the basis of path analysis it may be concluded that in 1971 the productivity of the phytomass had been mainly effected by the monthly precipitation, but "other" non-examined factors must also have had an important influence.

Introduction

Following our earlier preliminary investigations on production, conducted at the Csévharaszt IBP sample area (KOVÁCS-LÁNG—SZABÓ, 1971; SIMON—KOVÁCS-LÁNG, 1972), we restricted examinations to a study of the perennial open sandy meadow. *Festucetum vaginatae* is one of the associations highly characteristic of the sandy vegetation in Hungary. It has three different geographic variations (arrabonicum, danubiale, and deliblaticum) and several different subassociations (SOÓ, 1964). Its phytocoenological literature is quite extensive and its ecological conditions were also studied by many researchers (MAGYAR 1933, HARGITAI 1940, KÁRPÁTI 1954, 1955).

This was the object of the quantitative phytocoenological investigations by PRÉCSÉNYI (1962) who studied the distribution of biomass in this meadow. The stands of the sample area studied by him at Máriabesnyő had proved to be homogeneous in respect to the number of species. The distribution of the number of individuals and the biomass, however, did not prove to be homogeneous.

In his study PRÉCSÉNYI estimated biomass by the number of individuals being present in the unit area. This may be considered the first approximative quantitative examination of the phytomass of a *Festucetum vaginatae* community.

In the reservation area at Csévharaszt the most, widely spread and characteristic type of grassland is also the perennial open sandy steppe meadow.

By informative investigations our aim was to obtain further detailed information on the dynamics of organic matter in the plant-soil system, to compare the influence of the years with different weather conditions on the productivity of phytomass.

Material and method

The IBP sample area at Csévharaszt is one of the most beautiful original sandy forest-steppe vegetation area between the rivers Danube and Tisza. (See its characterization: KOVÁCS-LÁNG 1970, SIMON 1971, KOVÁCS-LÁNG — SZABÓ 1971, VERSEGHY—KOVÁCS-LÁNG 1971, SIMON—KOVÁCS-LÁNG 1972). For studying the dynamics of the phytomass we took $20 \times 20 \times 20$ cm adjacent monolith samples from elongately rectangular areas in the characteristic stands of *Festucetum vaginatae*. We collected 20 respectively 10 monolith samples monthly. We separated the phytomass to the following fractions: underground parts, aboveground floral dead parts, living floral parts and cryptogams (PRÉCSÉNYI 1967, MILNER-HUGHES 1968, KOVÁCS-LÁNG—SZABÓ 1971).

From the soil monolith containing underground parts we separated the roots by drying and sifting, using at frist sifters ganged 2 mm, then 0.2 mm. The separated fractions were weighed in air-dry conditions.

For determining the total organic matter of the soil we used TYURIN's $K_2Cr_2O_7$ wet destruction method (ARINUSKINA 1961).

From the percentage value of the "total humus", we calculated, knowing the bulk density of the soil, the quantity of organic matter accumulated in soil monoliths. Data of measurements were statistically evaluated, calculating fraction by fraction the averages and the variation of data. The influence of the monthly sample-taking, as treatment, was estimated by analysis of variance and significance (SVÁB 1967, 1973; PRÉCSÉNYI 1969, MÁTHÉ—PRÉCSÉNYI 1970). We tried to approach the relationship between certain environmental factors and the productivity of phytomass by correlation analysis, and their effect on the variability of productivity by path analysis (O'SVÁTH 1961, PRÉCSÉNYI 1971, SVÁB 1973).

Results

Organic matter of the soil

"Humus" fraction dominates the organic matter of monoliths, composing nearly half of the total organic matter. This means on average 0.40% humus concentration in the upper 20 cm horizon of the soil (determined after

TYURIN). At the same time, humus distribution in soil is not equal: in the upper 0—5 cm layer it exceeds 1%, under this layer it rapidly decreases. Since plant organic matter (root phytomas is given) also as a mean for the 20 cm horizon, we homogenized the soil for the determination of humus.

For the comparability we have to mention that the quantity of humus under the steppe vegetation, e.g. in a typical chernosem soil in which humus concentration is 4—6%, is about 20 times as much as the phytomass (KOVDA—JAKUSEVSZKAJA 1971). In our earlier humus quality investigations carried out in *Festucetum vaginatae* we demonstrated (KOVÁCS-LÁNG 1970) that in stands of deeper situations with a better water-supply, where the rich occurrence of *Tortella inclinata* is typical in the moss-lichen synusium, humus accumulation is smaller probably in consequence of the optimal decomposition conditions, and among the humus substances the fulvic acids with soluble smaller molecules linked to plant parts, predominate.

Accordingly the pH value in the soil of these stands is more acidic (pH in distilled water = 6.3).

In the "nudum" type soil occurirng on the dry habitat of the sand hills, tops, that is, in the soil of the typical steppe sward stands on a considerably more open soil surface, the quantity of humus substances humic acid type, with greater molecules and attached to mineral parts, increases. This implies that the biological humification is impeded several times, and that chemical humification plays a greater role in the formation of humus substances, producing them with greater molecules and of the humic acid type by the prevalence of polymerization and condensation processes.

The dynamics of soil organic matter and the changes of its ratio to phytomass during the vegetation period are well observable on the circle diagrams of Figure 1. About half of the total organic matter is the quantity of "humus".

At the beginning of the growing season its share is the smallest, then it rapidly increases until the beginning of June. The maximum share in June (56%) is followed by a decrease, the proportions in July, August and September are nearly stable. In October a higher proportion, as compared to that of earlier months can again be observed.

The quantity of organic matter of the monoliths (Table 1) varies between 36—62g/8 dm^3, equalling 900—1550 g per 1 m^2 soil with a depth of 20 cm that is, 9—15.5 t per hectare.

Characteristic of the seasonal changes of the soil organic matter is that after the medium value in April it reaches its maximum in May-June, then its quantity gradually decreases by autumn. SIMON—FÜLÖP (1966) also experienced a May-June maximum and decreasing summer values in their investigations on the *Festucetum vaginatae* stands of Szentendre Island.

The variation of data on the basis of CV% values is not high in relation

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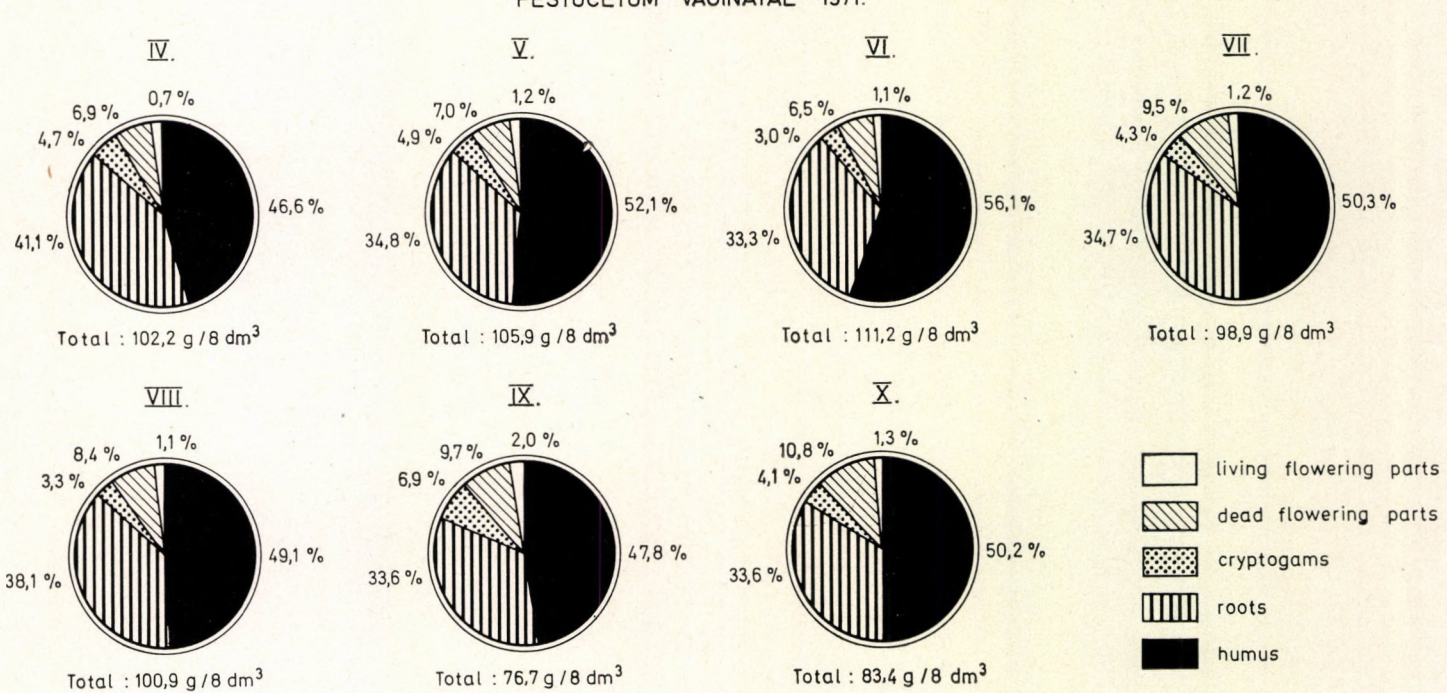

Fig. 1 Seasonal changes of the organic matter distribution within the monoliths during the growing season 1971

Table 1

Seasonal changes of soil organic matter in Festucetum vaginatae danubiale in 1971
"humus" g/8 dm³ (average of 10 samples)

Date of sampling	$\bar{x}$ s	CV%
13. IV.	48.8 ± 4.29	9.0
18. V.	55.12 ± 4.87	8.8
29. VI.	62.37 ± 6.88	11.1
19. VII.	49.75 ± 5.16	10.4
16. VIII.	49.50 ± 8.23	16.6
15. IX.	36.62 ± 5.43	14.8
13. X.	41.75 ± 4.22	10.1

LSD 5% = 5.81
1% = 7.74
0.1% = 10.01

Analysis of variance

Source of variability	SQ	df	MS
time of sampling	4227.94	6	704.65^{+++}
error	2685.18	63	42.62
total	6913.12	69	

F = 16.53
Note: +, ++, +++ mean the level of significant difference at 5%, 1% and 0.1% respectively.

to the phytomass fractions. This is probably the result of analyzing the soils by homogenization. Between the means of the consecutive months there is a significant difference at a 5% probability level in June-July and at a 0.1% level in August-September.

Variance analysis indicates the effect of months significant at 0.1% level.

Phytomass production

Within the phytomass the dominance of root phytomass can be observed; 35% of the total organic matter of the monoliths is represented by the roots.

Their share is the highest at the beginning of the growing season and it strongly decreases until June. The increasing share of the soil organic matter during the same period appears to show an inverse correlation. Presumably

in this period the degree of decomposition of roots exceeds that of growth, and thus the dead parts increase the organic matter of the soil.

In August the relative ratio of roots is high again then it decreases by autumn.

Changes in the root importance index (RII%) reflect the proportions of roots within the floral phytomass. In 1971 the tendency of the seasonal changes of RII% equaled the observations made in 1968, that is, the proportion of the roots to the total phanerogamous phytomass decreases by the end of the vegetation period. In 1971, however, its absolute values were smaller by 10% as compared to that of the earlier years. The probable causes were the accumulation on the soil surface of a great amount of undecomposed litter and the decrease of root production.

Changes of RII% in 1971:

months:	IV.	V.	VI.	VII.	VIII.	IX.	X.
	84.4%	81.0%	81.0%	76.4%	80.0%	74.1%	72.8%

The quantity of underground parts (Table 2) during the growing season shows no considerable fluctuation, varying between 25.8—42 g/8 dm^3 quantity of dry matter. Calculated for 1 m^2 surface and 20 cm depth, this quantity represents a root mass of about 645—1050 g weight, or 6.45—10,5 t/hectare, respectively.

This root phytomass proved to be substantially less than the quantity we weighed in 1968 (KOVÁCS-LÁNG—SZABÓ 1971). The minimum values at the end of the season were similar to those of 1968, but the maxima very high May-June absolute values (87—100 g/8 m^3,) — could not be observed in 1971.

The initial quantity of roots was already less in April 1971 than in 1968, then the period of rapid growth failed to come about, during the vegetation period the quantity of root phytomass showed basically a decreasing tendency with smaller fluctuations.

Within the phytomass fractions the variation of samples is smallest in the root fraction and it was somewhat smaller in 1971 than in 1968. In that year the highest variation occurred during the period of rapid growth. In 1971, when this period failed to occur, the variation was much lower.

Among the means of the consecutive months we found a value nearly reaching the 5% probability level only in April-May, whereas in August and September there happened to be a 0.1% significant difference.

As a result of variance analysis, the months show a significance effect at the level of 0.1%.

The aboveground phytomass of phanerogamous plants, and within this group especially the living phanerogamous represent a relatively small part of

Table 2

Seasonal changes of underground phytomass in Festucetum vaginatae danubiale in 1971
dry weight g/8 dm³ (average of 20 samples)

Date of sampling	$\bar{x}$ s	CV%
13. IV.	41.99 ± 10.53	25.1
18. V.	36.92 ± 8.07	21.8
29. VI.	37.01 ± 7.68	21.2
19. VII.	34.29 ± 9.93	28.9
16. VIII.	38.42 ± 11.50	29.9
15. IX.	25.80 ± 5.47	21.2
13. X.	27.08 ± 8.67	30.9

LSD 5% = 5.66
1% = 7.49
0.1% = 9.63

Analysis of variance

Source of variability	SQ	df	MS
time of sampling	4 008.34	6	668.06^{+++}
error	10 944.03	133	82.28
total	14 952.37	139	

F = 8.12

the total organic matter of the monoliths; during the vegetation period their share varies between 7.5—11%. Within this, however, the ratio of living parts is only 1—2%. The aboveground floral phytomass is the most significant in September and October, when the other fractions, especially those in the soil, decrease.

The aboveground floral phytomass (Table 3) varies between 7.8—10.6 g/400 cm² dry matter, corresponding to 195—265 g organic matter per m² surface, or 1.95—2.65 t/ha. The high proportion of dead organic matter within the total quantity during the whole growing season is rather striking: It seems that the meagre amount of living matter, originating during the low intensity growth process, perishes rapidly and turns into the dead plant matter fraction. The steady high level of this part can be explained by continuous death on the one hand, and by the small intensity of decomposition processes on the other.

Table 3

Seasonal changes of aboveground floral phytomass in Festucetum vaginatae danubiale in 1971 dry matter g/400 cm² (average of 20 samples)

Date of sampling	Total floral phytomass			Living floral parts			Dead floral parts		
	$\bar{x}$	s	CV%	$\bar{x}$	s	CV%	$\bar{x}$	s	CV%
13. IV.	7.80	± 2.78	35.7	0.72	± 0.48	66.3	7.08	± 2.65	37.5
18. V.	8.70	± 3.37	39.0	1.24	± 0.83	66.9	7.46	± 7.16	95.9
29. VI.	8.46	± 2.01	23.8	1.26	± 0.61	48.8	7.20	± 1.96	27.3
19. VII.	10.61	± 4.63	43.6	1.16	± 0.81	69.8	9.45	± 4.12	43.6
16. VIII.	9.57	± 3.41	35.6	1.11	± 0.55	49.5	8.46	± 3.33	39.4
15. IX.	8.97	± 2.63	29.3	1.55	± 0.84	54.2	7.42	± 2.35	31.7
13. X.	10.13	± 3.70	36.5	1.09	± 0.63	57.8	9.04	± 3.20	35.4
LSD 5% =	2.07			0.43			2.17		
1% =	2.73			0.57			2.95		
0.1% =	3.53			0.74			3.74		

Taking the absolute figures for the basis of calculation, it appears that in 1971 the quantity of living parts in the aboveground phanerogamous phytomass of the *Festucetum vaginatae* stands was only half of the quantity measured in 1968, whereas the dead floral phytomass in 1971 was twice as much as in 1968 (KOVÁCS-LÁNG—SZABÓ 1971).

The seasonal changes of phanerogamous phytomass are very similar to those of the earlier observations: the living parts show a not very striking May-June and September maximum, while the quantity of dead phanerogamous parts display an increasing tendency during the summer.

The variation of data in the total aboveground phanerogamous phytomass fraction is higher than in the case of roots, but lower than that of the 1968 samples. The dead phanerogamous fraction has somewhat higher CV% than that of the total phanerogamous, but there was a characterizably lower CV% value in 1971 than in 1968.

The variation rate of data is the highest in the living phanerogamous phytomass fraction. This value was the same in the two years discussed.

Among the means of the consecutive months, a significant difference can be observed in the living phanerogamous phytomass fraction at a 5% probability level in April-May and in August-September-October.

The monthly means of the dead phanerogamous phytomass show a 5% significant difference only in June-July.

Variance analysis (Table 4) showed that the monthly effect on the living phanerogamous phytomass fraction was significant at 5% level.

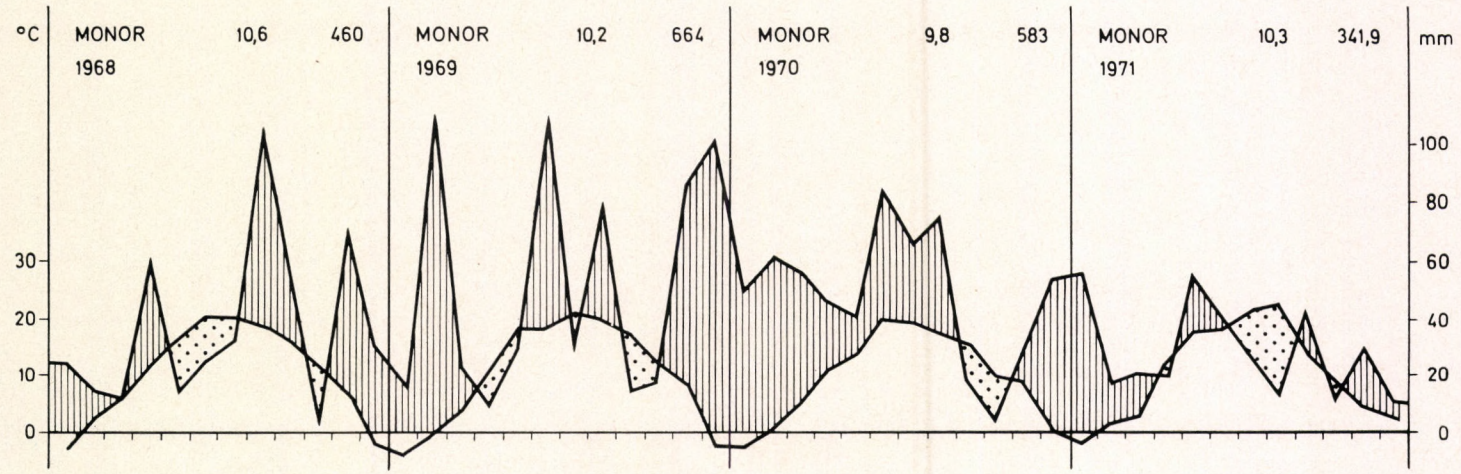

Fig. 2 The course of monthly mean temperature and amount of precipitation measured at Monor in the examined years

Table 4

Analysis of variance
Aboveground floral phytomass
Festucetum vaginatae danubiale, in 1971

Source of variability	Total floral phytomass		
	SQ	df	MS
time of sampling	118.53	6	19.75
error	1462.96	133	10.99
total	1581.49	139	

F = 1.79

Source of variability	Living floral phytomass = phytobiomass		
	SQ	df	MS
time of sampling	7.30	6	1.22^{+}
error	63.67	133	0.48
total	70.97	139	

F = 2.54

Source of variability	Dead floral phytomass		
	SQ	df	MS
time of sampling	116.16	6	18.53
error	1309.28	133	9.84
total	1420.44	139	

F = 1.9

No significant effect appeared in the case of dead floral parts. The monthly effect had no significance in case of the total aboveground phanerogamous phytomass, since they were mainly composed of dead matter.

The quantity of cryptogams amounts to 3—6% of the total monolith organic matter. Their proportion to the other fractions is the highest in September.

During the growing season their quantity (Table 5) varies between 3.4—5.3 g/400 cm^2. Reduced to square meters or hectares, we may calculate with 85—132 g and 8.5—13.2 q moss-lichen dry matter, respectively.

The cryptogamous phytomass also shows a substantial decrease against that observed in 1968.

Table 5

Seasonal changes of the cryptogam phytomass in Festucetum vaginatae danubiale community in 1971 dry matter g/400 cm² (average of 20 samples)

Date of sampling	$\bar{x}$ s	CV%
13. IV.	4.85 ± 2.42	49.9
18. V.	5.16 ± 3.32	64.3
29. VI.	3.40 ± 1.96	57.8
19. VII.	4.25 ± 1.74	40.9
16. VIII.	3.38 ± 1.15	34.0
15. IX.	5.32 ± 1.67	31.4
13. X.	3.43 ± 1.23	35.9

LSD 5% = 1.28
1% = 1.70
0.1% = 2.19

Source of variability	Analysis of variance		
	SQ	df	MS
time of sampling	90.09	6	15.01^{++}
error	558.50	133	4.20
total	648.59	139	

F = 3.6

Especially striking is the lack of autumnal increase. No great seasonal fluctuation can be observed. After relatively high values in April-May, a decline follows during the summer. Compared to this, an increase may be experienced in September, but in October a rapid decrease appears again. The variation of samples roughly corresponds to the results obtained in 1968.

Among the means of the consecutive months significant difference appeared at 1% probability level in May-June and in August-September-October.

Variance analysis also showed the effect of months, significant at 1% level.

The analysis of data revealed that the investigations carried out in 1971 showed a certain difference in the dynamics of phytomass fractions as compared to the situation in 1968. The absence of intensive growth processes and the coming into the foreground of considerable death of living parts are rather characteristic. At the same time, the significant accumulation of dead organic matter indicates the decrease of microorganic activity. We may regard as reasons for these fenomena the different weather conditions of the two years.

A comparison of the climatograms (Fig. 2) constructed on the basis of temperature and rainfall data of 1968 and 1971, shows that during the vegetation period in 1971 very unfavourable conditions had reigned. The higher average temperature and much lower rainfall resulted in a long arid period, strongly influencing the activity of the producent subsystem of the ecosystem.

The productivity of phytomass

The productivity values of the various phytomass fractions are in general fairly low (Table 6), indicating the low intensity processes enacted in the system. In the case of underground parts a positive productivity refers to growth in the periods May-June, July-August, and September-October. The values lag behind those measured in 1968. The total productivity calculated for the whole growing season proved to be negative, as in 1968 (KOVÁCS-LÁNG—SZABÓ 1973), but reached only one third of that found for 1968.

Because of the small growth rate and the substantial degree of decomposition, the moss-lichen fraction shows a very small negative productivity

Table 6

Phytomass productivity in Festucetum vaginatae danubiale in 1971

Number of days between dates of sampling	Aboveground parts g/400 cm²/day			Underground parts g/8 dm³/day
	Total phanerogamous	Living phanerogamous	Cryptogams	
IV.—V.				
35	+0.027	+0.015	+0.008	−0.145
V.—VI.				
42	−0.006	+0.0005	−0.042	+0.002
VI.—VII.				
20	+0.107	−0.005	+0.042	−0.136
VII.—VIII.				
28	−0.037	−0.002	−0.031	+0.147
VIII.—IX.				
30	−0.020	+0.015	+0.065	−0.421
IX.—X.				
28	+0.041	−0.018	−0.067	+0.081
IV.—X.				
183	+0.013	+0.002	−0.008	−0.076

related to the entire growing season. In 1968 the maximum growth in autumn resulted a positive total productivity in the cryptogamous fraction. In 1971 the positive and negative productivity values are low, both in the growing and in the deficit periods indicating the slowness of the processes.

The productivity of the aboveground phanerogamous phytomass also differs from that observed in 1968. Considering the entire period, there appear in 1971 in the total phanerogamous fraction somewhat higher positive productivity values, because of the greater quantity of dead organic matter, indicating more intensive accumulation. It is interesting that in 1968 the total productivity in the living phanerogamous fraction reached a very low, but still negative value.

In 1971 its sign changed into positive, but its value decreased to one third of the former.

The growth process of the aboveground living phytomass is well indicated by the course of organic matter accumulation.

The rate of production in 1971 of the total phanerogamous living phytomass, developed during the vegetation season, was as follows:

IV.	V.	VI.	VII.	VIII.	IX.	X.
9.0%	24.2%	40.0%	54.1%	67.7%	87.0%	100%

Comparing the accumulation values with those of 1968 (KOVÁCS-LÁNG—SZABÓ 1971), it can be stated that the organic matter accumulation in 1971 was protracted. In 1968, when we had more favourable weather conditions, by May the community had already attained 40% of its yearly production, and by July 65%. In the dry year of 1971 it seems to have been delayed by a month in comparison to the former one.

The turnover of phytomass

The aforesaid are supported by the values of the turnover rate of organic matter and of turnover time. In 1971 the turnover was much slower, with a substantial increase of turnover time in every phytomass fraction (Table 7).

Table 7

The turnover rate (%) and period (year) of the phytomass fractions in Festucetum vaginatae danubiale in 1971

Aboveground plant parts								Underground plant parts	
Total floral		Living floral		Dead floral		Cryptogams			
%	year	%	year	%	year	%	year	%	year
26	3.8	53	1.9	25	4	36	2.8	38	2.6

This is especially striking in the case of dead phanerogamous parts, where the turnover time increased from 1.2 year, calculated on the basis of 1968 dynamics, to 4 year in 1971.

Ecological efficiency

In 1971, the energy efficiency of the perennial open sandy meadow was also at a lower level than in the earlier years (Table 8).

The efficiency of aboveground floral phytomass showed the maximum in June-July, but this value could not reach the efficiency measured in the early summer period of 1968. No increase of energy utilization could be observed in the autumn period. In 1971, the efficiency of the cryptogamous fraction during the early summer period lagged behind by one scale that of the 1968 value. In autumn a certain increase could be observed, but its rate was far behind the earlier one.

Table 8

The values of the ecological efficiency in the periods of phytomass growth in 1971

Period	Aboveground total phanerogamous phytomass	Cryptogamous phytomass
IV.—V.	0.052%	0.015%
VI.—VII.	0.203%	0.080%
VIII.—IX.		0.20%
IX.—X.	0.17%	

Experiences of the statistical evaluations

Experiences gained in extending the sample plots since we divided an elongately rectangular sample area 20×400 cm into 20 closely touching monoliths ($20 \times 20 \times 20$ cm) our sampling made it possible to contract two neighbouring monoliths and work with them as one sample. In this way having reduced the number of samples to ten and thereby doubling their surface and changing their shape, we estimated performing the statistical evaluations also on the basis of estimating the phytomass of $20 \times 40 \times 20$ cm monoliths.

The variation of data has decreased. The decrease in the CV% values, however, was different in every phytomass fraction.

The variation of underground phytomass fractions, originally smaller than that of the aboveground phanerogamous parts, decreased at a lesser extent than in the latter case. The most striking decrease in the CV% value appeared in the aboveground living phanerogamous fraction, that is, in the living matter of its dominant component, *Festuca vaginata*. The contract effected to a lesser extent the variation of the cryptogamous fraction than that

of the phanerogamous phytomass. The analysis of variance of the contracted samples showed changes in two fractions. The effect of months on the variance of aboveground phanerogamous living phytomass showed significance on the contracted samples at 0.1% level, in contrast to the earlier level of 5%. Changes of an opposite trend was found in case of the cryptogamous fraction, where, as a result of the contraction, the months proved to be less significant than originally.

The effect of environmental factors on the primary productivity of Festucetum vaginate danubiale in 1971

Analyzing the dependence relations of the phytobiomass primary productivity values measured in 1971, a path analysis was performed to investigate the effect of climatic factors. For the analysis, we used the data of the Meteorological Station at Monor, about 3 km from our sample area.

In the correlations of the climatic factors (Table 9), the most definite positive relationship existed between the total radiation and the montly mean

Table 9

Correlation coefficients (r) between productivity and the factors studied Festucetum vaginatae danubiale, 1971

Factors	b	c	d	i	p
a	+0.37	−0.40	+0.84	+0.71	+0.13
b		+0.42	+0.33	+0.53	+0.85
c			−0.12	−0.50	+0.55
d				+0.15	+0.17
i					+0.31

Symbols:

a = monthly mean temperature C°
b = amount of monthly precipitation mm
c = relative air humidity %
d = amount of monthly total insolation cal/400 cm^2/day
i = soil pH in distilled water
p = productivity of the phytobiomass

temperature. A medium positive correlation occurs between the values precipitation and relative air humidity. A negative relationship of a similar value exists between relative air humidity and temperature.

In 1968, when the *Festucetum vaginatae* community was examined for the first time, the trends of relationships between the climatic factors were similar to those in 1971, except the precipitation of relative air humidity pair,

which showed a weak negative correlation in 1968 (KOVÁCS-LÁNG—SZABÓ 1973). In 1968, the most definite correlation was between relative air humidity and total radiation.

In the investigations we tentatively included also a soil factor actual chemical reaction of the soil. The soil specific feature changes with climatic conditions, and, according to our present knowledge, shows hardly explainable correlations. The most definite correlation concerns changes of temperature. The correlations between changes of precipitation quantity and relative air humidity are medium.

Characteristic to the relationship between phytomass productivity and the environmental factors of the present investigations is that there appears a strong positive correlation in the case of precipitation, and a medium but also positive correlation in that of relative air humidity. Investigations in 1968 did not show as close a correlation with precipitation as those in 1971, indeed the correlation coefficient [r_{tp}] showed a not too definite, but negative relationship. The correlation between relative air humidity and productivity, however, seemed to be quite similar in the two years.

According to the results of path analysis (Table 10), changes in precipitation quantity affected most directly the productivity of phytobiomass in *Festucetum vaginatae* in 1971. The second most important ones were the "other

Table 10

Path coefficients between phytobiomass productivity and affecting factors (A) and the percentage rate of the different factors (B)

	Direct effects					Indirect effects	"Other" effects
	P_a	P_b	P_c	P_d	P_i		
A)	+0.1087	+0.9085	+0.1124	−0.1852	−0.1614		0.4826
B)	1.18	82.54	1.26	3.43	2.60	14.30	23.30
	Intensity order of the effects of the examined factors						
	4	1	3	6	5		2

factors", on that occasion not drawn within the scope of investigation. The other factors studied, e.g. soil pH in water, exerted a negligible direct effect.

We carried out the analysis also with disregard to the effects of soil pH. Neither the orders of magnitude nor that of sequence of the climatic factors changed.

The substantial increase in the role of precipitation in 1971 was probably due to the fact that 1971 was a year very poor in rainfall. It is possible that

under a certain threshold value it becomes a limitating factor among the climate factors and that is why it had a strong direct effect in that year. Similarly to the earlier investigations, the role of "other" factors, beside the climatic ones, was again outstanding in the open *Festucetum vaginatae.*

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DATA TO THE PRECIPITATION INTERCEPTION OF A GALATELLO-QUERCETUM ROBORIS (FOREST STEPPE — FOREST) AT ÚJSZENTMARGITA

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Studies on the precipitation interception of the forest in the IBP sample area at Újszentmargita revealed that it depends on the quantity of precipitation and the season. Precipitation interception amounts to 23—25% during summer. Intensity studies showed that half of the daily 2—3 mm precipitation is intercepted and evaporated by the canopy. The ratio of transmitted precipitation increases by the increase of the daily amount of precipitation, while the ratio of interception by the canopy decreases. Results agree with those obtained by other authors.

Regarding the investigation of the water regime of plant associations, a knowledge of the amount of incoming precipitation transmitted to or into the soil is rather important. The various plant associations have diverse leaf and branch structures (physiognomical structure) and hence diverse precipitation interceptions. A forest greatly influences the amount of precipitation arriving onto the soil surface: a smaller amount may be completely intercepted by the canopy, while even a more copious rainfall wets the canopy only slowly, and arrives at first merely as a drizzle onto the ground level.

The distribution of precipitation in the forest stand can be expressed by the following equation (LEONARD, 1967):

$$P = T + D + F + S + E$$

where P = atmospheric precipitation above the forest,
T = water transmitted through the canopy,
D = water dripping from the canopy,
F = trunkflow,
S = water "stored" by the canopy (the amount necessary to wet the leaves),
E = evaporation loss on the canopy.

The combined amounts of T and D represents precipitation transmitted, the amounts S and E those intercepted, by the canopy.

The seasonal variation of the quantity and quality of the foliage also plays a decisive role in the amount of transmitted water.

At the onset of precipitation, a part of the rainfall is used for the wetting of the leaves and the immediately beginning evaporation. The combined amount of wetting and evaporation losses is termed the precipitation interception of the forest. Wetting loss varies between 0.3—7.6 mm according to the tree species. GEIGER (1961) records this amount as being 1—3 mm.

Investigations concerning interception began by E. HOPPE in Austria in 1896. The relevant literature was published by GEIGER (1961). On the basis of a series of measurements running for more than twenty years, EITINGEN (1951) studied the dimensions of interception and recorded an annual mean of 32% for the Scotch fir, 14% for the spruce, and 9% for the birch, as related to an annual 545 mm of precipitation. GRUNOV (1965) studied the interception of spruce forests, CEPEL (1967) that of beech, oak, and Scoth fir forests. The value in question was 7—10% in the beech forest on the Hosszúbérc, Mts. Bükk, WAGNER (1957).

Study area and methods

The Meteorological Institute of the L. KOSSUTH University of Sciences, Debrecen, began the heat and water budget of the "Tilos" forest at Újszentmargita (NE border of the Hortobágy National Park) in 1966. Measurements concerning interception were made in 1971—1972, in the forest (*Galatello-Quercetum roboris polygonatetosum latifolii*), on the forest clearing (*Peucedano-Galatelletum punctati*), and on the treeless pasture (*Achilleo-Festucetum pseudovinae*) adjoining the forest. The detailed description of the plant associations were made by ZÓLYOMI (1967), and a survey of the primary production of the associations by ZÓLYOMI, MÁTHÉ, PRÉCSÉNYI, and SZŐCS (1972). At the sites of measurements, the forest is of a half-dry water regime type; in full canopy with 80% cover for the upper and 20% for the lower foliage canopy layers (TALLÓS and TÓTH, 1968). *Quercus robur* predominates in the upper, and *Acer tataricum* in the lower, canopy layers.

Measuring techniques

To measure precipitation transmitted by the forest canopy, normal (HELLMANN) precipitation implements with a 200 cm^2 receiving surface are used in several repetitions, or vessels with multiply larger surfaces (applied in 1 m^2 or even greater, 20×100 cm basic sizes), or precipitation collectors (mainly in mountainous regions). The normal or HELLMANN's precipitation installations are used chiefly for the measurement of daily amounts and their correlations with treeless areas, in every case in multiple repetitions to counteract the inhomogeneities of the canopy. An advantage of applying vessels with a larger total surface is a better representation. GRUNOV (1965) studied the sizes and forms of instruments measuring precipitation, and also defined the size giving the best results.

For the measuring of precipitation passing down the trunks, a substance reliably adhering to the trunks must be used to collect the total trunkflow amount. For trees with a smooth bole (e.g. beech), a rubber ring is suitable, but it will not completely fill in the cracks of the rind of oak-trees. For such trunks, a polyuretane foam cast in situ is servicable; its application was published by LIKENS and EATON (1970)*.

In want of a suitable implementation, trunkflow was not measured in the Újszentmargita forest, but according to the data published by CEPEL (1967) and others this amounts to 6—7% of the total precipitation in oakwoods, and still less in old stands. In order to have a trunkflow, a precipitation of 5—7 mm is necessary in oakwoods, but only 1.5—2.5 mm in beech forests, to present measurable trunkflow quantities.

* Investigations in this respect will commence presently in the study project concerning the complex ecosystem at Síkfőkút. (M. SZABÓ, 1975).

During our investigations, HELLMANN precipitation implements have been used in every site. In closed stands 3, on the forest clearing and on the treeless pasture one each, of these devices have been applied, in every case at an altitude of 1.m. Precipitation measurements were made daily — depending on the rainfall — in all three sites from early spring till late autumn.

Results

The results of measurements in 1971—1972 are summed up in Table I, for five months in 1971 and for seven months in 1972.

Table 1

Monthly amounts of precipitation of various sites of measurement in 1971 and 1972, and the ratio of precipitation transmitted by the forest canopy (in %)

1971	Forest clearing mm	Forest mm	Transmitted %
May	27.1	22.0	81.2
June	49.4	38.0	76.9
July	37.8	26.5	70.1
August	39.3	34.0	86.5
September	34.9	24.6	70.5
Total	188.5	145.1	77.0

1972	Pasture mm	Forest clearing mm	Forest mm	Forest clearing — forest %	Pasture — forest %
April	21.9	24.7	15.7	63.5	71.7
May	66.8	73.1	58.3	79.7	87.2
June	64.2	66.3	57.4	86.6	84.7
July	76.3	85.3	59.5	69.7	78.0
August	62.6	64.3	49.8	77.4	79.5
September	38.7	43.1	29.3	65.6	73.5
October	19.6	21.2	16.6	78.3	84.6
Total	350.1	378.0	285.6	75.5	81.6

As related to the forest clearing, only 77.0% of the summer semiannual mean of 1971 arrived at the forest ground level, with 23% of the precipitation having been intercepted and evaporated by the canopy. In 1972, from April till October, this ratio was 75.5%, an insignificant difference between the two years. The ratio between the pasture and the forest gives higher values (81.6%), and the distance is also considerably greater. These per cent values are higher than those measured by CEPEL, but his data were obtained in a considerably younger (54 years old) stand, possibly of a decisive influence.

The ratio of transmittence shows a definite annual course in deciduous forests. During winter, when the canopy is absent, the intercepted amount depends also on the state (quality) of the precipitation. In deciduous forests, the crown intercepts merely 10% of the solid precipitation, and 90% is transmitted to the ground. According to GEIGER's (1961) published data, the winter interception is 6% smaller than the summer one in beechwoods. No change occurs in the amount of trunkflow. Summer interception depends, besides the density of the canopy, also on the intensity of precipitation, and the correlation is inverse.

Owing also to the greater intensity, the transmitted precipitation increases during the summer months; e.g. it was 33.7 mm on the forest clearing on 9 May, 1972, 31.5 mm in the forest, the transmission was 93.5% (the interception 6.5%), whereas on 19 May, when it rained the whole day, the precipitation was 10.3 mm and 5.2 mm, respectively — the canopy transmitted only 50.5% (the interception having been 49.5%).

Investigating futher the effect of intensity on precipitation interception, the daily amounts of precipitation was studied in a frequency table, applying 2.5 mm intervals up to 10.0 mm, and 5.0 mm ones above 10.0 mm. Table II

Table II

Magnitudinal distribution of daily precipitation amounts of the pasture, forest clearing, and in the forest

1971—72	Number of cases	Pasture mm	Forest clearing mm	Forest mm	Forest clearing — forest %	Pasture — forest %
0.0— 2.4	31	—	1.1	0.5	—	44.5
2.5— 4.9	26	—	3.4	2.1	—	61.8
5.0— 7.4	11	—	6.2	5.1	—	82.2
7.5— 9.9	5	—	8.3	6.8	—	81.9
10.0—14.9	6	—	11.1	8.5	—	76.6
15.0—19.9	6	—	16.7	13.1	—	77.8
20.0—29.9	3	—	23.4	21.0	—	89.7
30.0—	2	—	39.5	30.2	—	90.1
1972						
0.0— 2.4	27	1.3	1.6	0.7	53.8	43.7
2.5— 4.9	17	3.6	3.7	2.7	75.0	73.0
5.0— 7.4	11	6.2	7.2	5.6	90.3	77.8
7.5— 9.9	2	9.3	9.8	7.2	77.4	73.5
10.0—14.9	3	13.1	11.9	10.5	80.2	89.2
15.0—19.9	3	18.3	16.3	12.4	71.2	76.1
20.0—29.9	1	—	23.4	20.9	—	89.3
30.0—	2	33.3	33.6	30.2	90.6	89.9

presents the results of frequency computations, obtained as follows. Daily precipitation amounts were assigned into groups within the indicated orders of magnitude. Within the period of measurements, there occurred measurable precipitation on 90 occasions during the two years, with amounts below 2.5 mm in 31 occasions. The mean of the first class interval is 1.1 on the forest clearing, and 0.5 mm in the forest. The difference between the two was intercepted by the canopy, and transmitted merely 44.5%. The year 1972 was studied also separately, and a transmission of 43.7% was received in the average of

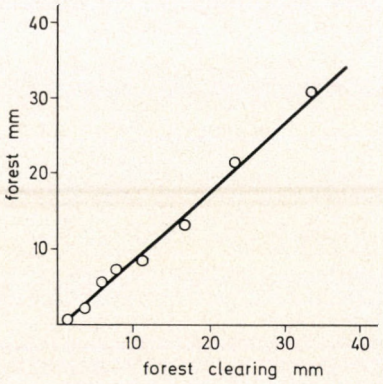

Fig. 1 Correlation between the daily precipitation amounts of the forest and the fores clearing

27 occasions. It can be stated that in the case of a precipitation smaller than 2.5 mm per day, the interception is more than 50%. (The distance between the two sites of measurement is merely 50 m). For the forest and the pasture, the value is 53.8. For an average 2 – 3 mm daily precipitation, half of this amount is intercepted and soon evaporated by the canopy. The proportion of the transmitted precipitation increases with the increase of the daily amount of precipitation, hence the amount intercepted by the canopy decreases. In our calculations, the uncertainty factor is high in the case of 20 mm, or greater, amounts of daily precipitations, since greater values occurred in not too many cases, or rather, a longer series of measurements is necessary to establish correct correlations.

The correlation concerning the precipitation amounts per day of the forest clearing and the forest can be expressed by the equation

$$Y = 0.9056 \cdot X - 0.7388$$

where Y equals the amount of precipitation below the forest canopy, and X that measured on the forest clearing (Fig. 1). It appears that a daily amount

of precipitation less than 1 mm is wholly intercepted by the canopy. This correlation agrees with the values measured and calculated by TRIMBLE and WEITZMAN (1954) in West Virginia, the intensity of the precipitation having been established by registration.

The interception of the canopy results in the reception of the ground level from the summer precipitations being smaller than that of the open areas and that, accordingly, it must economize with less water than the treless regions.

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ABOVEGROUND BIOMASS OF QUERCUS PETRAEA AND QUERCUS CERRIS IN THE RESEARCH AREA AT SÍKFŐKÚT*

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Our investigations were made within the ecosystem research program launched by the Botanical Institute of the L. KOSSUTH University, Debrecen, in 1972, and connected with the MAB Program (JAKUCS 1973). In the oak forest of the research area (Síkfőkút Project) the quantity of the organic matter of the tree layer and its distribution in the aboveground components (foliage, branch, stem) were calculated.

Description of the Research Area

The forest studied is near the village Síkfőkút in the hilly country on the southern part of the Bükk Mountains (North Hungary), 300 m a.s.l. The upper substrate is brown forest soil, on loess-like sediment settled on Miocene pebble. The age of the forest is about 60—65 years, a climazonal oak forest. The tree layer is dominated by *Quercus petraea* and *Quercus cerris*, the shrub layer by *Cornus mas*, *Cornus sanguinea*, *Acer campestre*, *Acer tataricum*, *Ligustrum vulgare*, *Euonymus verrucosus*. The most important herb species are *Melica uniflora*, *Carex montana*, *Carex michelii*, *Poa nemoralis*, *Festuca heterophylla*, etc. The number of trees in the tree layer is 816 per hectare (*Quercus petraea* 84.5%, *Quercus cerris* 15.5%), the average height of trees 17.4 m (*Quercus petraea* 17.2 m, *Quercus cerris* 18.7 m), the average diameter at breast height 20.5 cm (*Quercus petraea* 20.1 cm, *Quercus cerris* 22.8 cm). The percentage of ground surface covered by the foliage of the trees is 80% (JAKUCS—HORVÁTH—KÁRÁSZ 1975).

Methods

The aboveground biomass of the trees and the weight of their components (foliage, branch, stem) were estimated by measuring sample trees. Regressions of the dry weight of the sample trees on their easily measured dimensions were calculated. By these regressions, the weight of individual trees were calculated for a hectare.

The following method was applied for selecting sample trees of *Quercus petraea*. After the diameters of all trees had been measured at breast height (DBH) on a study plot of 50×100 m, they were arranged in DBH size-classes. Trees were selected random from each size-class to be cut as regards class frequency; 10 each for foliage weight estimation, 26 for branch and

* "Síkfőkút Project No. 7"

stem weight estimations. Owing to their relatively small number, only 5 sample trees o *Quercus cerris*, with an average diameter, were chosen in the same plot.

The sample trees of the destruction sample plot in the research area were cut between 15 August and 15 September. After felling the following measurements were taken:

entire height of tree
stem height to first foliage branch
stem diameter below lowest living branch
number and basal diameter of branches within the crown (divided per tree into the following size-classes: under 1, 1—3, 3—5, 5—7, 7—10, and over 10 cm).

After these measurements were taken all branches of the sample trees were cut and separately weighted together with the leaves. The individual foliage weight of the sample trees was calculated as follows. 100 sample branches of 10 *Quercus petraea* and 50 ones of 5 *Quercus cerris* were taken random, in both cases with diameters of 1—3 cm. The fresh weight of leaves of individual sample branches was measured. Regressions of leaf weights on branch diameters of both species were computed. The individual foliage weights of tres were calculated by these regressions. After the removal of branches, the stems were cut into logs of 1 m and weighted. Leaf, branch and stem samples of determined fresh weight were dried at 85 °C to reach constant weight.

The relationships between dimensions and dry weights were described by power function (allometric regression):

$$\log y = \log a + b \log x$$

where x is DBH (cm), y is the dry weight of the total aboveground part, or components (foliage, branch, stem, stem + branch), of the trees (kg), a and b are constants (KITTREDGE 1944, PEARSALL-GORHAM 1956, ATTIWILL 1962, 1966, SATOO 1962, 1966, WHITTAKER-WOODWELL 1968, TELFER 1969, NEWBOULD 1970, SVÁB 1973, etc.). Regressions were computed and curves fitted by the method of least squares after prior transformation to logarithm on computer (type ODRA 1204). Correlation coefficient (r), standard deviation (Sy) and coefficients of variation (CV) were also computed

$$\left(Sy = \sqrt{\frac{1}{n} \sum (y_{\text{i measured}} - y_{\text{i calculated}})^2} \, , \right.$$

$$\left. \text{CV} = \frac{Sy}{\bar{y}_{\text{measured}}} \cdot 100 \right).$$

Results

Regression

The constants of regression equations between DBH (x) and dry weight (y), and the r, Sy, CV values of the relationships, are given in Table 1 and their scatter diagrams plotted in Fig. 1. As Table 1 reveals there is a close relation between DBH (x) and total aboveground weight of sample trees of both oak species. The relation between the individual dry weight of components (foliage, branch, stem, stem + branch) and DBH is also close. This is shown by the high values of r and the low values of Sy and CV. It was found by several authors that log aboveground weight is in closer relation with dimension log $DBH^2 \cdot h$ (h = height of tree) than with log DBH (OVINGTON-MADGWICK 1959, ATTIWILL 1962, OVINGTON et al. 1968, PETERSON et al. 1970, ZAVITKOVSKI-STEVENS 1971). Higher correlation coefficients were observed by ATTIWILL (1962), LOOMIS et al. (1966), PETERSON et al. (1970) between log

Table 1

Regressions for components of Quercus petraea and Quercus cerris on diameter at breast height (DBH). (All regressions are in the form log y = log a + b log x in which y is dry weight (kg) and x is DBH (cm); r correlation coefficient, Sy standard deviation, CV coefficients of variation; log a = A^x.)

Components		A^x	b	r	Sy log unit	CV log unit
Foliage	1.	0.000	2.8150	0.821	0.048	
	2.	−0.0020	2.8410	0.734	0.128	
Branch	1.	−2.6370	3.3906	0.842	0.138	7.68
	2.	−9.6916	8.5326	0.952	0.019	1.08
Stem	1.	−1.2827	2.6256	0.951	0.054	2.53
	2.	−4.4860	5.0763	0.945	0.012	0.52
Stem + branch	1.	−1.3307	2.7898	0.973	0.042	1.80
	2.	−5.3208	5.7761	0.987	0.006	0.26
Foliage + stem	1.	−1.3205	2.7897	0.974	0.041	1.75
+ branch	2.	−4.9998	5.5457	0.982	0.007	0.30

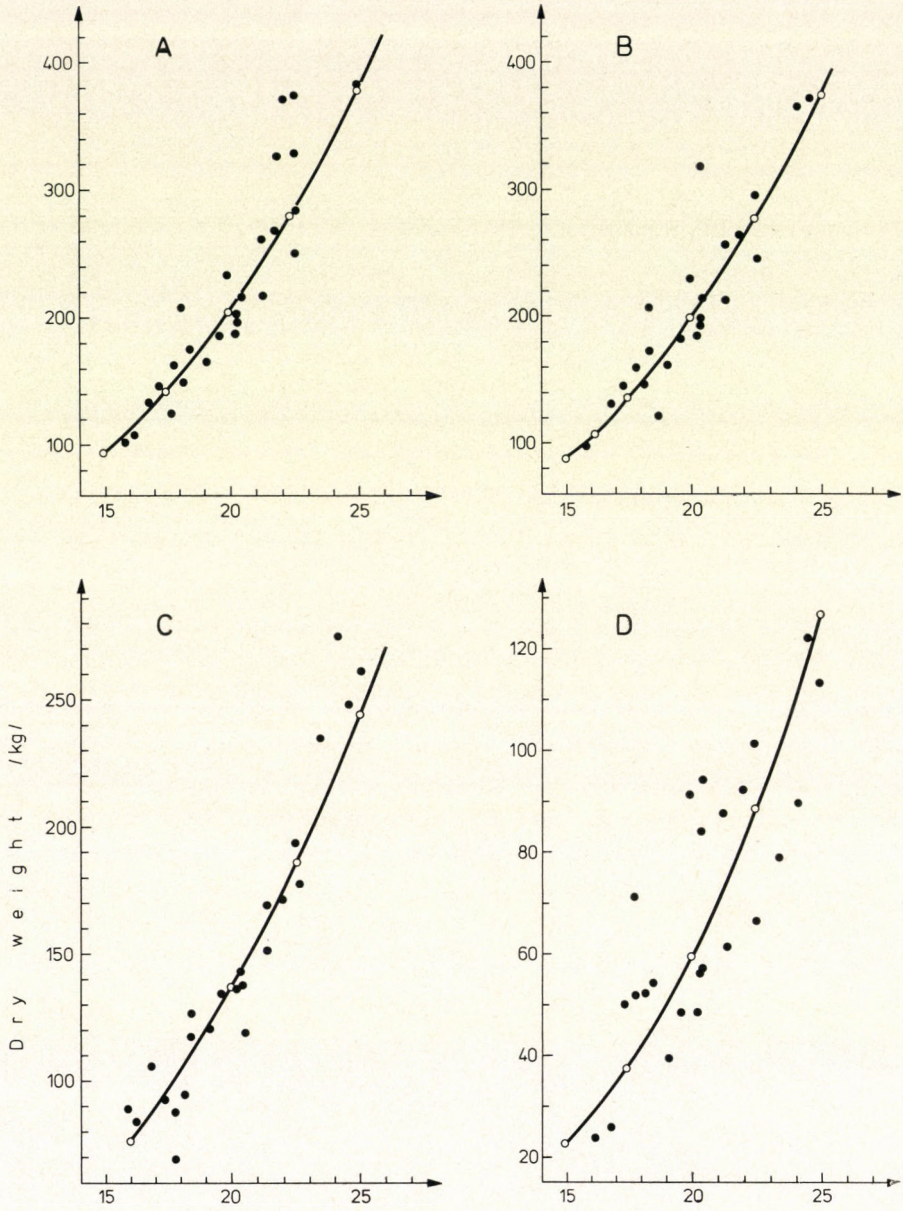
(P = 5%)

1. *Quercus petraea*
2. *Quercus cerris*

dry weight of crown, branch, and foliage and log stem diameter at crown base. By examining the cut sample trees we also noticed closer relationships, in agreement with above mentioned authors (see in details B. PAPP 1973). In spite of this we used the regressions based on DBH dimension for estimating biomass, as it is rather difficult and laborious to measure the two latter (height of tree, diameter at crown base) dimensions.

Aboveground Biomass

The aboveground biomass of the research area and its distribution between the two species and among the components are contained in Table 2. Dry weight of aboveground biomass of the tree layer is 186 t/ha. The greater proportion of biomass (80.9%) is represented by *Quercus petraea*, and 19.1% by *Quercus cerris*, according to the frequency of the two species. The greatest part (68.8%) of the total aboveground biomass is given by the stem, 28.9% by the branch and 2.3% by the foliage component. According to MAYER's estimation (oral report) the total aboveground tree volume is 300 m^3/ha (estimated from yield table), which corresponds to 198 t/ha dry weight.



Continuation and text of Fig. 1. see on the next page

The average weights of the tree species of the research area were calculated from the estimated weights of the trees on the study plot of 50×100 m. The weights of the components and the total weight of average trees are given in Table 3. This Table indicates that the total aboveground dry weight and

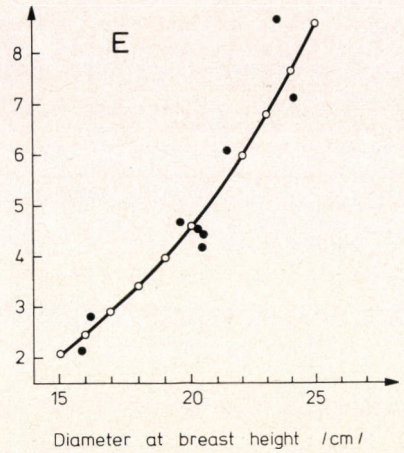


Fig. 1. Scatter diagrams for component dry weight (kg) and diameter at breast height (cm) for the sample trees of Quercus petraea (A, total above-ground part; B, stem + branch; C, stem; D, branch; E, foliage)

Table 2

Aboveground biomass of Quercus petraea and Quercus cerris in the research area at Síkfőkút (dry weight t/ha)

	Foliage	Branch	Stem	Total
Quercus petraea	3.43	46.37	100.80	150.60 (80.9%)
Quercus cerris	0.83	7.40	27.18	35.41 (19.1%)
Total	4.26 (2.3%)	53.77 (28.9%)	127.98 (68.8%)	186.11 (100%)

Table 3

Average dry weights of Quercus petraea and Quercus cerris in the research area at Síkfőkút (in kg)

	Foliage	Branch	Stem	Total
Quercus petraea	4.9 (2.2%)	67.3 (30.8%)	146.3 (67.0%)[0]	218.5 (100%)
Quercus cerris	6.5 (2.3%)	58.3 (20.9%)	214.0 (76.8%)[0]	278.8 (100%)

stem weight of the average *Quercus cerris* is bigger and its branch weight smaller than the corresponding weights of the average *Quercus petraea*. The results can be explained by the different structures of the two species. The stems of *Quercus cerris* are longer, the crowns smaller and sparser than the corresponding parts of *Quercus petraea*. There is no essential difference in the foliage weights between the two species, in spite of the fact that the average leaf number of *Quercus cerris* individuals is much smaller (40,200 leaves) than the averages of *Quercus petraea* (55,800 leaves). The reason is the greater dry weight of an average leaf of *Quercus cerris* (*Quercus cerris* 0.1617 g/leaf, *Quercus petraea* 0.0892 g/leaf).

Summary

The results of analyses in the tree layer of the aboveground biomass in the oak forest (dominated by *Quercus petraea* and *Quercus cerris*) at the Síkfőkút research area are presented. Aboveground biomass and its distribution per components (foliage, branch, stem) were estimated by allometric regressions (regressions of dimension-weight), calculated from data of cut sample trees.

Close relationships ($r = 0.73—0.98$) between log diameter at breast height (DBH) of trees and dry weight of their components (foliage, branch, stem, total aboveground part) were recognized (Table 1).

According to calculations, the aboveground biomass of the tree layer is 186 t/ha (dry weight) in the research area. Its distribution between the two oak species is as follows: *Quercus petreae* 156 t/ha, *Quercus cerris* 35 t/ha. The biomass is represented by the following components (in per cent of total aboveground biomass): foliage 2.3%, branch 28.9%, stem 68.8% (Table 2). The average dry weight of trees, calculated from estimated biomass data, is 218 kg/individual *Quercus petraea*, 279 kg/individual *Quercus cerris* (Table 3).

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ESTIMATION OF PHYTOMASS DRY-WEIGHT OF EPIPHYTIC MOSSES AT SIKFŐKÚT (NEAR EGER, N HUNGARY)*

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The phytomass of epiphytic moss cover has been studied on trunks of a colline oak stand in the Síkfőkút sample area (near Eger). A method of estimation has been elaborated.

In a given area (200 m^2, 14 trunks) the epiphytic moss cover was divided into three thickness groups and both the total coverage (tinfoil = foil + paper method) of the individual thickness groups and the average weight of 100 cm^2 samples stated.

On the basis of the assessment made in January 1973, the total coverage showed 5.296 m^2 (14 trunks), while the total dry-weight (net production) amounted to 827.5 g. Converted into hectares, this sum equals 41 375 g. The distribution of the species on the trunks show a xero-mesic and continental microclimate. A comparision of *Hypnum cupressiforme* samples from January and May 1973 reveals a significant decrease. This change is closely related to changes in precipitation and temperature values.

The estimation of primary production in the Síkfőkút sample area in one of the first steps in a series of investigations (JAKUCS 1973) planned to reveal the structure and functioning of the colline oak ecosystem. In this context, I have studied the composition of moss species in the canopy layer and collected samples in order to estimate their phytomass.

At a height of 300 metres above sea level and sloping gently to the south, the sample area lies in the hilly region of the Bükk Mountains adjoining the Great Hungarian Plain. The substrate consists of Miocene pebbles overlain by loess-like sediments, bearing a clay-illuviated brown forest soil. The pH-value of horizon "A" is 4.8—5.7, the amount of exchangable cations as follows (me/100 g) : Ca = 12.1, Mg = 2.06, K = 0.57, Na = 0.09 (KOVÁCS in JAKUCS 1973). The annual mean temperature reaches: 9 °C, the annual mean precipitation amounts to 560 mm, while the sum of insolation hours is 2085. The climazonal Turkey oak — sessile oak forest (*Quercetum petraeae-cerris*), a sprouted wood, is a stand of about 65 years of age. *Quercus petrae* ssp. *petraea* dominates in the canopy layer (84 per cent), though it is mixed to some extent with *Quercus cerris* (16 per cent). More important species of the shrub layer are: *Acer campestre*, *A. tataricum*, *Crataegus monogyna*, *Cornus mas*, *C. sanguinea*, *Euonymus verrucosus*, *Lingustrum vulgare*. The mean diameter of the trunks at chest height is 20 cm, mean height 17.3 m. The shrub layer reaches 3 metres

* "Síkfőkút Project" No. 11.

in height. Facies-forming species of the herb layer are: *Carex michelii*, *C. montana*, *Poa nemoralis*, *Melica uniflora*. Frequent species: *Festuca heterophylla*, *Dactylis polygama*, *Fragaria vesca*, *Lathyrus niger*, *Chrysanthemum corymbosum*, etc. (JAKUCS 1973).

Mosses occur only rarely on the soil (*Mnium cuspidatum*), while in the lower part of trunks at a height of about 1.5 metres moss covers of a few species can be seen. Here *Hypnum cupressiforme* dominates, accompanied by *Platygyrium repens*, *Bryum capillare* var. *flaccidum*, *Brachythecium salebrosum*, *Mnium cuspidatum*, *Anomodon attenuatum*, *Frullania dilatata*, *Ulota ulophylla*, *Neckera besseri*, etc. In the stands of the neighbouring eroded valleys with fresher soils the moss vegetation is more interesting, the relict species *Brachyodontium trichodes* on a shaded rhyolite-tuff cliff is worth mentioning (SIMON 1973).

Method

In January and May 1973, 100 cm^2 samples were collected from epiphytic moss species. The samples were divided into 3 thickness groups. 1) Thick cover in the lowest part of the trunk; 2) cover of medium thickness in the lower part of the trunk; 3) thin cover in the middle part of the trunk. The samples were cleaned of the bark particles, afterwards divided into living and deaded fractions and measured in air-dry conditions. For each thickness group the average weight of the species as well as the dispersion of the mean value have been calculated. In an area of 200 m^2 the moss coat of each trunk was carefully covered with tinfoil, and after ist removal we spread it over a table and fixed its outline (Photos 1, 2). Following this, the dividing lines of the several species and thickness groups were marked. The pattern thus gained were cut along the dividing lines, the weight of each paper was measured and proportionated to a piece of paper of a known area and the weights converted to cm^2. The square centimetre was multiplied by the corresponding mean weight (Table 1). For the calculations of weight of the *Hypnum* cushions belonging to thickness group no. 3, the mean weight data of *Platygyrium* were used. The data of primary net production are based on the measurements made in January. The difference between the phytomass weight data of January and May were controlled with the "t" test (SVÁB 1973). Cover values at the time of both samplings were practically identical.

Table 1

Mean weight of the moss samples (January 1973)

Species	Thickness group	Sample size N	Phytomass (g/100 cm^2)					
			living		dead		total	
			Mean	Standard error of mean	Mean	Standard error of mean	Mean	Standard error of mean
Hypnum cupressiforme	1	10	1.243	0.113	1.979	0.313	3.222	0.122
H. cupresssiforme	2	8	0.951	0.047	0.811	0.016	1.762	0.056
Platygyrium repens	3	3	0.408	0.014	0.382	0.011	0.790	0.018
*Mnium cuspidatum**	2	4	0.804	0.058	1.142	0.024	1.946	0.083
Bryum capillare	2	3	0.822	0.023	1.099	0.059	1.922	0.082
B. capillare	3	2	0.354	—	0.293	—	0.647	—

* On the basis of material collected in the neighbourhood of the sample area; no occurrence on the 14 trunks of the sample area.

Photo 1. Estimation of epiphytic moss cover in a Turkey oak — sessile oak stand at Síkfőkút (Photo: T. SIMON)

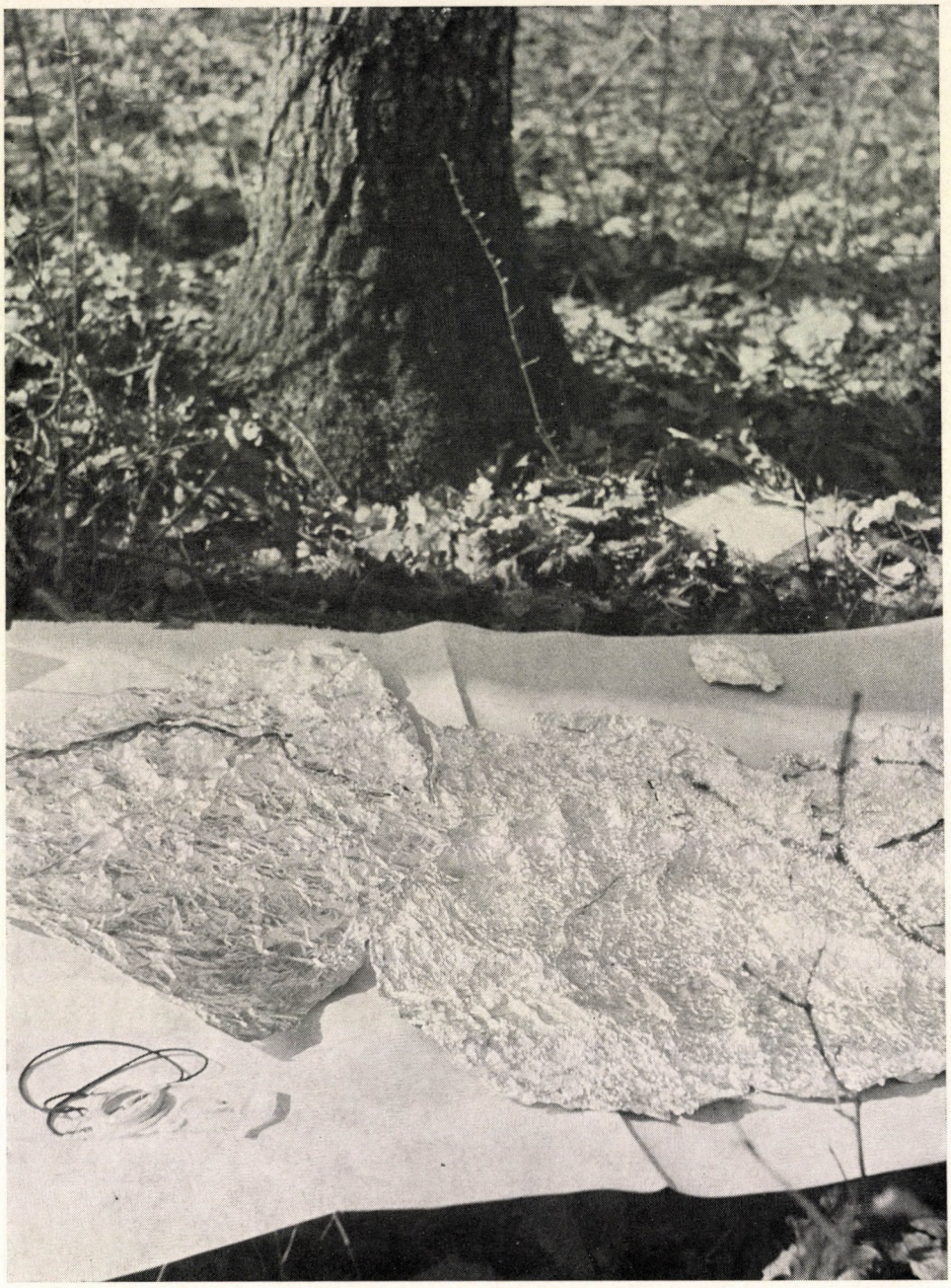

Photo 2. Tinfoil spread on a sheet of paper, its circumference drawn by a pencil (Photo: T. SIMON)

Discussion of results

On the basis of the assessment made in January 1973, the net production of the epiphytic moss layer of the *Quercetum petraea-cerris* sated was succesfully estimated. The cover on the 14 trunks of the 200 m² stand is 5.295 m², its weight amounts to 827.5 g. Converted into hectares, this sum is 41 375 g (Table 2).

Table 2

Phytomass of epiphytic mosses per trunk in the 200 m² area of the Turkey oak — sessile oak stand near Síkfőkút

Trunk no.	Moss cover in cm²	Moss phytomass (g)		
		living	dead	total
1	4 226	25.954	23.229	49.183
2	731	5.816	5.031	10.847
3	4 330	34.662	29.965	64.627
4	1 739	10.401	9.254	19.655
5	3 478	27.213	34.166	61.379
6	5 617	27.733	25.261	52.994
7	8 783	50.946	45.490	96.436
8	3 494	28.888	24.908	53.796
9	2 695	16.658	14.768	31.426
10	2 503	15.346	13.566	28.912
11	5 217	61.039	88.013	149.052
12	3 495	18.603	16.782	35.385
13	5 322	60.567	89.662	150.229
14	1 339	12.733	10.859	23.592
	52 969	396.559	430.954	827.513

This quantity may be regarded in Hungarian relation as a weak medium value. The quantity of epiphytic phytomass is probably higher in mixed forests on fresh soil (*Querco-Carpinetum*), in forests of shaded and rocky mountain gorges (*Phyllitidi-Aceretum*, *Parietario-Aceretum*), in the forest stands of stony ridges and slopes with detritus (*Mercuriali-Tilietum*) and in the forests of flood plains (e.g. *Querco-Ulmetum*) and in marshy woods (e.g. *Carici elongatae-Alnetum*).

In the *Quercetum petraeae-cerris* sample area at Síkfőkút the dominating species of the epiphytic moss cover is the euryök *Hypnum cupressiforme* (Table 3). Its thicker carpets (thickness group no. 1) cover the trunks up to the height of 15—20 cm, the medium carpets (thickness group no. 2) up to

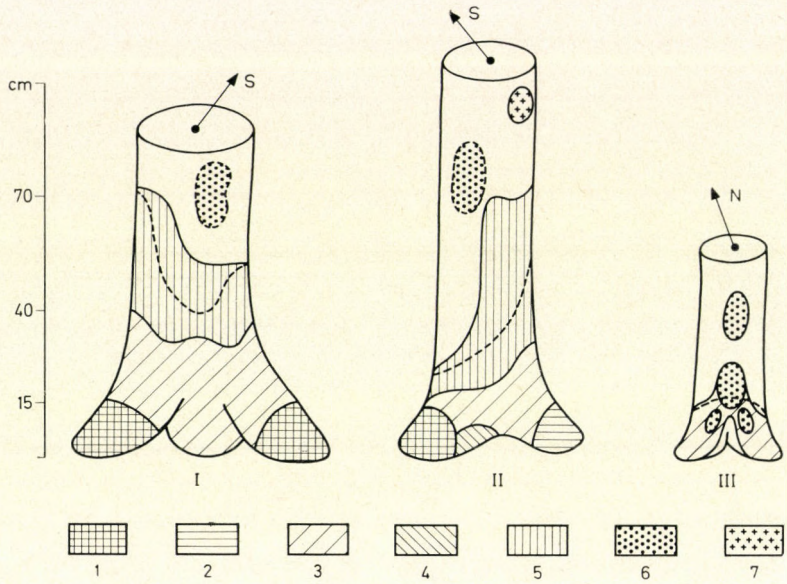

Fig. 1. Epiphytic moss cover types on the trunks of trees in the Síkfőkút Turkey oak —sessile oak sample area. — I., II.: *Quercus petraea*, III.: *Qu. cerris*; *1* = *Hypnum cupressiforme*, thickness group no. 1; 2 = *Brachythecium salebrosum*, thickness group no. 2; 3 = *Hypnum c.*, thickness group no. 2; 4 = *Bryum capillare*, thickness group no. 2; 5 = *Hypnum c.*, thickness group no. 3; 6 = *Platygyrium repens*, thickness group no. 3; 7 = *Frullania dilatata*, thickness group no. 3. The moss cover on the other side of the trunk is delimitedly dotted lines

30—50 cm the thin ones (thickness group no. 3) are to be found up to 40—70 cm. The major part of the *Hypnum* cover appears on the northern side of the trunks; *Platygyrium* occurs mostly on their southern face (Fig. 1). About

Table 3

Cover of epiphytic moss species (cm²) and weight (g) on the 14 trunks of the 200 m² area, broken down according to thickness groups (nos. 1, 2, 3)

Species	cm²			g			total (cm²)	total (g)
	1	2	3	1	2	3		
Hypnum cupressiforme	9 165	18 850	21 721	290.59	336.80	171.60	49 736	798.99
Platygyrium repens	—	—	2 729	—	—	21.57	2 729	21.57
Brachythecium salebrosum	—	261	—	—	4.59	—	261	4.59
Bryum capillare	—	52	104	—	1.00	0.68	156	1.68
Frullania dilatata	—	—	87	—	—	0.69	87	0.69
							52 969	827.52

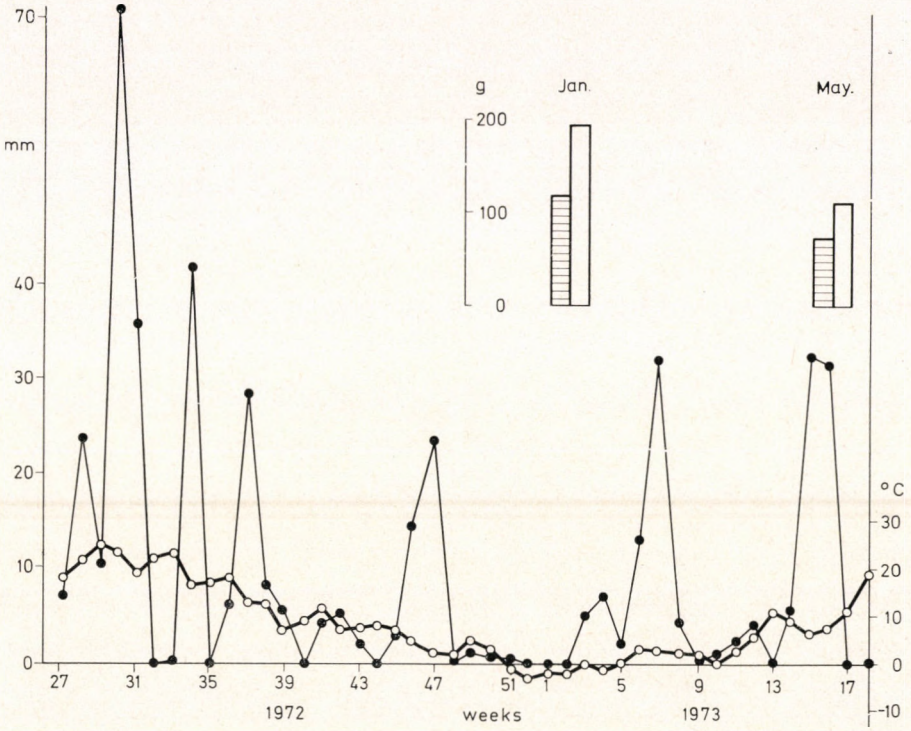

Fig. 2. Climatogram made on the basis of weekly mean temperatures (heavy line) and weekly precipitation values (thin line). On the vertical axis to the right the values of temperature (in °C), on the axis to the left those of precipitation (in cm) are given. The weekly temperature means were calculated on the basis of daily means, that of weekly precipitation on the basis of daily totals. Right above, diagrams of the dry-weight of *Hypnum cupressiforme* cushions (thickness group no. 1), measured in the lowest part of the trunks in January and May (living fraction shaded, dead fraction blank)

60—70 per cent of the moss cover and about 80—90 per cent of its weight fall to the northern side of the trunks. This distribution well expresses the xeromesic microclimate and the continental character of the studied Turkey oak — sessile oak stand. This type of distribution is generally characteristic of several regions in Hungary and it may be traced to the temperate Central European climate of a continental-submediterranean character. Another kind of distribution has been published e.g. by HOFMAN and KAZIMIERSKI (1969) from the temperate pine woods in the U.S.A. (*Pseudotsuga menziesii*), notably from the Olympic Peninsula. There the dry-weight data of the xeromesophytic *Hypnum circinale* and *Dicranum fuscescens* (Hoh River sites) show a decrease upwards on the SW side of the trunks (0—3 metres) and downwards on their NE side. The mesophyton (mesic) species *Scapania bolanderi* shows in both exposures its greatest quantity at the foot of the trees.

This distribution is influenced by local microclimatic factors, therefore they are potentially valuable as indicators.

Comparing the weights of the samples taken in January and May of the *Hypnum*-cover growing on the lowest part of the trunks at Síkfőkút (thickness group no. 1), a significant decrease can be stated as regards both the living and dead fractions (Table 4). This change is in close correlation with the development of the corresponding values of precipitation and temperature (Fig. 2).

Both the estimation of weight and the tracing of changes of the epiphytic moss cover contribute to the clarification of its role in the life, material and energy turnover of the oak ecosystem.

Table 4

Phytomass of Hypnum-moss cover growing in the lowest part of the trunks (thickness group no 1, on 916 cm of 3 trunks) measured in January and May

N = 8	January			May		
	living	dead	total	living	dead	total
Mean	1.243	1.979	3.222	0.810	1.169	1.979
Standard error of mean	±0.113	±0.313	±0.388	±0.134	±0.169	±0.193
Phytomass (g)916 cm²	11.39	18.10	29.05	8.10	10.70	18.00

$t_{5\%} = 2.15$ $t = 2.46$ (g)916 cm²) (living) $t = 2.27$ (g/916 cm²) (dead) $t = 2.75$ (g/916 cm²) (total)

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THE CURRENTLY VALID NAMES AND RECENT SYSTEMATIC POSITION OF SPECIES PREVIOUSLY RELEGATED TO THE GENUS ORCHIS IN EAST AND SOUTH-EAST ASIA AND IN NORTH AMERICA

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On the basis of the recent literature (Soó, HUNT, VERMEULEN), the author compiled the list of the species included formerly in the *Orchis* genus of East and South-East Asia as well as North America. Today these are included in the *Aorchis*, *Amerorchis*, *Chondradenia*, *Dactylorhiza* (— as a supplement, the taxa of these in Central and South Asia), *Galearis*, *Ponerorchis* (syn.: *Chusua*) genera. *Orchis puberula* is an *Amitostigma* species, not *Ponerorchis* as suggested by VERMEULEN.

I attempted to give a brief survey — as a preliminary communication — of the species previously relegated to the genus *Orchis* in East (and South-East) Asia and North America (Acta Bot. Acad. Sc. Hung. **12**, 1966). Subsequently several authors discussed the systematical position and nomenclatura of these species, especially HUNT (1971) and VERMEULEN (1972, publ. 1973). The genus *Galeorchis* Rydberg 1901 is identical with *Galearis* Rafinesque 1836 this latter is the valid name (nom. conserv. Taxon **17**: 462, 1968), so that HUNT listed as *Galeorchis* all species trated under the former name (My paper, the same result, was submitted to the Acta Bot. Acad. Sci. Hung. already in 1970, but HUNT's treatise rendered its publication superfluous.) However, VERMEULEN separated two further genera: *Chondradenia* Maxim in Makino (1902) and the recently described *Aorchis* (with the species *A. spathulata*), in his opinion the species *Orchis cyclochila* — which I treated as *Galearis cyclochila* already in 1969 (p. 72) — is also neither an *Orchis*, nor a *Galearis*, but probably assignable to a new genus.

HUNT discarded the name *Ponerorchis* Rchb. f. 1852 (*Chusua* Nevski 1935) on the ground that it was later drawn in by RCHB. f. 1878 under *Gymnadenia*. This, however, is erroneous, since the floral structure evinces that of *Orchis* (cf. Vermeulen 1972) and thus *Ponerorchis* Rchb. f. emend. Ohwi is the correct generic name of the species I enumerated, HUNT's re-namings were erroneous. The sole exception concerns *P. rotundifolia*, recently described by HULTÉN (1966) as representative of also a new genus. *Orchis puberula* King et Pantley 1898 is an *Amitostigma* species, not *Ponerorchis*, suggested by VERMEULEN 1972, p. 30. The distinctness of some taxa, described as species, is

disputable — I have drawn several of them together already in 1929. In the twenties (1925—1927) I had occasion to examine, in the herbaria of Vienna, Berlin and London-Kew, the original exemplars of numerous species of the region, described as *Orchis* or the related genera, and then occasionally emend their systematical and nomenclatorial status (Soó 1929). At that time I have considered the genus *Orchis* in a wider sinse; later researches had partly changed this: I accepted SCHLECHTERS's several new genera (e.g. *Amitostigma*), while the exact relegation of some species is doubtful even today, those which have been clarified are listed below. SCHLECHTER described as new species some taxa which have been considered in earlier European orchideology at most as varieties (some authors recently qualify these as taxonomical valueless, e.g. SENGHAS), while others describe as species or varieties the various specimens of even the same population (DANESCH) — transforming the investigation of the orchids into the play-ground of amateurs.

No species belonging to *Orchis* s.str. occurs in the region. Concerning the orchids occurring in the Soviet Union, cf. my summary (1969). Recent Chinese literature is unavailable, hence its data (distribution, eventual new taxa) could not be considered.

Aorchis spathulata (Lindley 1835 sub *Gymnadenia*) Vermeulen 1973 (*Galeorchis sp.* Soó 1966, *Galearis sp.* Hunt 1971) Huc:
var. **wilsonii** (Schltr. Acta Horti Gotob. 1934 : 132 sub *Orchide*) Soó comb. n. et var. *foliosa* Finet
Himalaya, Tibet, China (Sechuan, Yunnan, Kueichou) cf. Soó 1929 : 348

Amerorchis rotundifolia (Banks ex Pursh 1814 sub *Orchide*) Hultén Ark. Bot. 7 : 35 (1968) (*Ponerorchis rot.* Soó 1966) N-America

Chondradenia doyonensis (Hand.-Mazz. 1936 sub *Orchide*) Vermeulen 1973 (*Galeorchis doy.* Soó 1966, *Galearis doy.* Hunt 1971) China (Yunnan)

Ch. fauriei (Finet 1898 sub *Orchide*) Sawada 1934 nom. illegit., ex Maekawa 1971 nom. legit. (*Orchis chondradenia* Makino 1902 — in Soó 1897 *erratum-*, *Galeorchis ch.* Soó 1966, *Galearis fauriei* Hunt 1971)
Japan

Dactylorhiza aristata (Fisch. ex Lindl. 1835 sub *Orchide*) Soó 1960 nom. illeg. 1962 nom. legit.
Far East, Korea, Japan, N-America (Isles Aleutian, Alaska)

Galearis cyclochila (Franch. et Savat. 1879 sub *Habenaria*) Soó Ann.Univ. Budapest, Sect. Biol. **11** : 72 (1969) (*Galeorchis cycl.* Nevski 1935) et var. *palczewskii* (Kränzl. 1913 sub *Orchide*) Soó l. c. Anne ad genus separatum novum pertinet? (cf. VERMEULEN 1973 : 34—35). Nec tubera, nec rhizoma, sed radices crassae
Far East (SSSR: Ussuri), Korea, China (Manchuria), Japan

G. constricta (L. O. Williams 1938 sub *Orchide*) Hunt 1971 (*Galeorchis* c. Soó 1966)

China (Yunnan)

G. ferrieana (Kränzlin Viert. Nat. Ges. Zürich **60** : 425, 1915) Hunt 1971
Japan, sed species dubia, deest in Ohwi Fl. of Japan

G. paxiana (Schltr. 1924 sub *Orchide*) Hunt 1971 (*Galeorchis pax.* Soó 1966)
China (Chili)

G. subrotunda (King et Pantling 1897 sub *Orchide*) Hunt 1971
Burma

G. stracheyi (Hook. f. 1890 sub *Orchide*) Hunt 1971 (*Galeorchis str.* Soó 1966)
Himalaya

G. szechenyiana (Rchb. f. ex KANITZ 1891 sub *Orchide*) Hunt 1971 (false "*G. szechenijiana*")
China (Kansuh, Sechuan)

G. wardii (W. W. Sm. not. Roy. Bot. Gard. Edinb. **13** : 215 sub *Orchide*) Hunt 1971
China. Specimen visum valde mancum, probabiliter ad *G. cyclophilam* pertinet, secundum diagnosim *Aorchidi spathulatae* affinis (Soó 1929 : 345)

Ponerorchis beesiana (W. W. Sm. Not. Roy. Bot. Gard. Edinbg. 1914 : 193 sub *Orchide*) Soó comb. n. (*Orchis exilis* Ames et Schlecht. 1919) Secundum Schltr. 1919 et 1923 *Orchis* sp. —planta tuberosa — ergo *Ponerorchis*, secundum TANG et WANG Acta Phytot. Sinica **1** : 57 (1951) *Amitostigma*, Taxon dubium, ideoque deest in Soó 1966.

Orchis axilis (Schltr. 1919) ex diagnosi *O. chusuae* similis, sed de structura stigmatis nulla mentio est!, habitus etiam a specieibus *Amitostigmae* (planta foliosa, inflorescentia multiflora) diversa.

O. beesiana (ex Schltr. 1923) etiam ad affinitatem *O. chusuae* pertinet. Sed haec species duae sunt eaedem. (Originalia! cf. Soó 1929 : 344).

Orchis puberula Kingl et Pantley haud est *Ponerorchis* (Vermeulen 1973 : 30), sed *Amitostigma puberula* Schltr. 1919 : 93, resp. Tang et Wang Bull. Fan. Mem. Inst. Biol. Peiping, Bot. ser. **7** : 6 (1936), Acta Phytot. Sinica **1** : 57 (1951). Ideo in enumeratione Soó 1964 deest.

P. brevicalcarata (Finet 1897 sub *Hemipilia*) Soó 1966 (*Chusua b.* Hunt 1971)
China (Yunnan)

P. chidori (Makino 1892 sub *Habenaria*) Ohwi 1936 (*Chusua ch.* Hunt 1971)
Japan

P. chrysea (S. W. Sm. 1921 sub *Habenaria*) Soó 1966 (*Chusua ch.* Hunt 1971)
Tibet, China-W.

P. chusua (D. Don 1823 sub *Orchide*) Soó 1966 (*O. roborowskyi* Maxim. 1887, *Galeorchis rob.* Nevski 1935, *Chusua donii* Nevski 1935, *Ponero. rob.* Hunt 1971)

var. **delavayi** (Schltr. 1911 sub *Orchide*) Soó 1966 (*Ponero. rob.* var. *del.* Hunt 1971, *Orchis chusua* var. *del.* Soó 1929) var. giraldiana (Kränzlin 1905 sub *Orchide*) Soó 1966 (Hunt l. c., Soó l. c.)

var. **tenii** (Schltr. 1921 sub *Orchide*) Soó 1966 (Hunt l.c., Soó l.c., ?*Orchis paxiana* Schltr. ex Limpr., cf. Soó 1929 : 344—345)
var. **unifoliata** (Schltr. 1921 sub *Orchide*) Soó 1966 (Hunt l.c., Soó l.c.)
subsp. **nana** (King et Pantley Ann. Roy. Bot. Gard. Calcutta ó : 304, 1898) Soó comb. n. (Soó 1966 p. sp., *Ponero. roborowskyi* var. *nana* Hunt l.c.)
Himalaya, Burma, Tibet, China (Yunnan, Sechuan, Hupeh, Shensi, Kansuh etc.)
subsp. *nana* Himalaya

P. crenulata (Schltr. 1924 sub *Orchide*) Soó 1966 (*Chusua c.* Hunt 1971)
China (Yunnan)

P. curtipes (Ohwi Bull. Nat. Sc. Mus. Tokyo **1** : 1 (1954) sub *Orchide*) Soó 1966 resp. hoc loco
Japan

P. diantha (Schltr. Acta Horti Gotob. 1924 : 31 sub *Orchide*) Soó comb. n. (*Galeorchis d.* Soó 1966, *Galearis d.* Hunt 1971) Planta tuberibus praedita (cf. Hand.-Mazz. 1324!), ideoque non ad Galeorchidem pertinet!
China

P. graminifolia Rchb. f. 1852 (*Gymnadenia gram.* Rchb. f. 1878, *G. rupestris* Miq. 1865, *Orchis gram.* Tang et Wang 1940, *O. rupestris* Schltr. 1919) Non est *Gymnadenia*, uti SUMMERHAYES (1957) et HUNT (1971) credunt, sed typus generis *Ponerorchis* (cf. Vermeulen 1972 : 30)
var. **suzukiana** (Ohwi Journ. Jap. Bot. **44** : 15 (1969) p. var. *Orchidis gram.*) Soó comb. n.
Japan

P. hemipilioides (Finet 1901 sub *Gymnadenia*) Soó 1966 (*Chusua hem.* Hunt 1971), sed species dubia, cf. SCHLECHTER 1919 : 90, HAND.-MAZZ. 1326, forsan var. *P. monophyllae*
China (Yunnan)

P. hui (Tang et Wang 1936 sub *Orchide*) Soó 1966 (*Chusua hui* Hunt 1971)
China (Yunnan)

P. joo-iokiana (Makino 1902 sub *Orchide*) Nakai Bull. Nat. Sci. Mus. Tokyo **31** : 152 (1952), Soó 1966 (*Orchis matsumurana* Schltr. 1919)
Japan
var. **coreana** (Ohwi Acta Phytot. et Geobot. **5** : 145 (1936) sub *Orchide*) Soó comb. n. -Korea

P. kiriashiensis (Hayata 1920 sub *Orchide*) Ohwi 1936 (*Chusua kir.* Hunt 1971)
Taiwan

P. kunikikoana (Masamune et Fukuyama 1936 sub *Orchide*) Soó 1966 (*Chusua kun.* Hunt 1971)
Taiwan

P. limprichtii (Schltr. 1924 sub *Orchide*) Soó 1966 (*Chusua l.* Hunt 1971)

Tibet, China-W.

P. monophylla (Collett et Hemsley 1890 sub *Habenaria*) Soó 1966 (*Chusua mon.* Hunt 1971, *Orchis geniculata* Finet 1901)
Burma, Tibet, China (Yunnan, Kweichou)

P. pauciflora (Lindl. 1835. sub *Gymnadenia*) Ohwi 1936 (*Chusua pauc.* Hunt 1971)
Siberia-E, Korea, Manchuria, China (?)

P. pulchella (Hand.-Mazz. 1936 sub *Orchide*) Soó 1966 (*Chusua pulch.* Hunt 1971)
China (Yunnan)

P. taiwanensis (Fukuyama 1935 sub *Orchide*) Ohwi 1936 (*Chusua t.* Hunt 1971
Taiwan

P. takasago-montana (Masamune 1934 sub *Orchide*) Ohwi 1936 (*Chusua t.-m.* Hunt 1971) Taiwan

Appendix. *Dactylorhizae* species in Asia-S et Central-E:

D. graggeriana (Soó 1928 sub *Orchide*) Soó 1930 nom. illeg., 1932 nom. legit.
Himalaya (Kashmir)

D. hatagirea (D. Don 1823 sub *Orchide*) Soó l.c.
Himalaya (India, Kashmir, Nepal), Tibet
var. *schlaginweitii* (Soó 1928 sub *Orchide*) Soó l.c. Tibet
var. *doniana* (Soó 1928 sub *Orchide*) Soó l.c. Tibet

D. incarnata (L. 1735 sub *Orchide*) Soó l.c. var. *subincarnata* (Rchb. f. 1851 p. var. *Orchidis latifoliae*, Soó 1929 p. var. *O. incarnatae*). Taxon dubium, an hybridogeneum, e Dshungaria (orig. Rchb. f.!) et Sibiria publicata, cf. Soó 1929 : 347, deest in Soó 1930. 1932, 1969

D. salina (Turcz. ex Lindl. 1835 sub *Orchide*) Soó 1930 nom. illeg., 1932 nom. leg.
Hsinchiang, Tibet, China (Kansuh), Mongolia, Far East, cf. Soó 1929, 1969

D. umbrosa (Karo et Kiril. 1842 sub *Orchide*) Nevski 1937 Hsinchiang-Uiguri: Dshungaria-Tarbagatai, ceterum in USSR, cf. Soó 1969

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DEM ALTMEISTER DER PFLANZENZÖNOLOGIE, PROF. DR. H. C. J. BRAUN-BLANQUET ZUM 90. GEBURSTAG GEWIDMET

DIE PFLANZENGESELLSCHAFTEN DER MITTELEUROPÄISCHEN BUCHENWÄLDER IN UNGARN

Von

R. Soó

BOTANISCHER GARTEN DER L. EÖTVÖS UNIVERSITÄT, BUDAPEST

(Eingegangen 1. II. 1974)

The author presented a survey of the SE European *Fagion* federations and associations in his book published in 1964. The beech forests belonging to the *Fagion medioaeuropaeum* in Hungary are now discussed (concerning those assignable to *F. illyricum*, cf. Borhidi 1963—1964), to wit: *Aconito-Fagetum* Soó, *Melittio-F.* Soó (*M.-F. subcarpaticum*), *Laureolae-F.* Soó (*Mel.-F. hungaricum*), *Cyclamini -F.* Soó (*Mel.-F. noricum*). Their compositions are shown on the Table, and for the sake of comparison also those of the associations *Querco cerri-Luzulo-Fagetum* (Magyar) Soó and *Galio rotundifolio-F.* Soó (*Deschampsio flexuosae-F.* auct. hung.), relegated to the acidophilous *Deschampsio-Fagion.*

The author remains true to the terms and methods of the BRAUN-BLANQUET school, discussing the association in a regional meaning, under double names, with geographical names applicable only to geographical variants. For the validity of names he holds sufficient the "characteristic species combination" (BR.-BL. 1928) or the "Konstanzliste", and even more the synthetic list or table. In his opinion the present usage is incorrect: the placing into the genitive case of the name of the first species when treating composite names, e.g. *Querco roboris-Carpinetum*, the correct being the dative case (*Querco robori-C.*). He also disapproves of the so-called "objective statistical" or computerized methods, presumably solely able to show the relationship or identity of plant associations, because they disregard qualitative significance, character species, the synecology of the associations, etc.

In meinem Buch über die regionalen *Fagion*-Verbände und Gesellschaften Südosteuropas habe ich die mitteleuropäischen Buchenwälder als *Fagion medio-europaeum* Soó 62 [Syn.: *Fagion* Luquet 26, Pawl. 27, Tx. et Diem. 36, *Fraxino-Carpinion* Tx. 37 p. p.] von den Verbänden *Scillo-Fagion* Oberd. 57 [SW-Europa, z. B. Pyrenäen], *Fagion austro-italicum* Soó 64 [incl. *F. mediterraneo-montanum* Hofmann 62, Süditalien, von den Zentralapenninen bis Sizilien] — vgl. die Literatur bis 1963 in dem zitiertem Werk, seitdem viel neue —, *F. illyricum* I. Horvat (38) 50 [Westbalkan, aber auch Slowenien, Kärnten wohl bis Südsteiermark, ferner der südliche Teil des ungarischen Transdanubiens] — eingehende Monographie von BORHIDI (1963—64) vgl. dazu das neue posthume Werk von I. HORVAT und Mitarbeiter, *F. dacicum* Soó 60 [incl. *F. moesiacum* I. Horvat, die Buchen und Eichen-Hainbuchenwälder der Ostkarpaten bis Westukraine, sowie Ostbalkan [vgl. auch Soó 69] — und *F. orientalis* event. *Fagetalia orientalis* Soó 64, aufgrund

der Kenn- und Trennarten der Verbände und Assoziationen, im Sinne der klassischen Charakterartenlehre von unserem gemeinsamen Altmeister der europäischen Pflanzensoziologie bzw. Phytozönologie, J. BRAUN-BLANQUET, getrennt. Ebenso habe ich in meinen verschiedenen Übersichten der pannonischen bzw. ungarischen Vegetationstypen die Verbände *Asperulo-Fagion* bzw. *Eufagion*, *Cephalanthero-Fagion* Tx. 55, *Tilio-Acerion* Klika 55 [*Acerion pseudoplatani* Oberd. 57] und *Carpinion betuli* [Issler 31 p. p.] Oberd. 53 meist als Unterverbände behandelt. Hier möchte ich nur die Phytozönosen der echten mitteleuropäischen Buchenwälder näher betrachten, da die illyrischen Buchenwälder auf ungarischem Boden schon von BORHIDI l. c., BORHIDI und PÓCS in SOÓ 62, 64, A. O. HORVÁT 72 ausführlich besprochen wurden. Ebenso behandelten die Eichen-Hainbuchenwälder Ungarns während des Reinhardbrunner Symposiums BORHIDI 68, CSAPODY 68, es fehlt noch die Zusammenfassung der Felsen- und Schluchtwälder. Sonst gab ich eine neue Übersicht aller unserer *Fagetalia*-Wälder 71: 158—163 bzw. 73: 596—604, aber als Grundlage dazu dienen die Übersichten SOÓ 62 und 64: 238—261. Nur die ausgesprochen azidophilen Buchenwälder gehören zur Ordnung *Pino-Quercetalia* SOÓ 62 (non Ružička 64) der Klasse *Quercetea roboripetraeae* Br.-Bl. et Tx. 43, und zwar die südost-mitteleuropäischen Buchenwälder zum Verband *Deschampsio-Fagion* SOÓ 62, 64 (*Luzulo-Fagion* auct. non Lohm. et Tx. 54), da die mitteleuropäischen Ass. *Luzulo-Fagetum* Markgr. 32 em. Meusel 37 (*Melampyro-F.* Oberd. 57) und das später (1968) in 5 Ass. aufgeteilte *Deschampsio-F.* Pass. 1956 bis Polen viele in SO-mitteleuropäischen azidophilen Buchenwäldern fehlende Kennarten des *Quercion robori-peraeae* aufweisen, statt deren andere *Pino-Quercetalia* usw. Trennarten südlichen Charakters auftreten (vgl. SOÓ 71: 166—67, 73: 609—610). In der Tabelle der ungarischen *Asperulo-Fagion* Assoziationen —die ich früher *Melitti-Fagetum* SOÓ 1962 (*Melico-F.* auct. hung.) benannt habe als Hauptass. mit 3 regionalen Ass.-nen* — wurden zum Vergleich auch einige Stetigkeitslisten der nordungarischen (col. 20) und der westungarisch-burgenländischen (col. 21—23) azidophilen Buchenwälder aufgenommen.

* Zuerst 57 habe ich diese Wälder mit dem *Melico-Fagetum* Knapp 42 identifiziert. Der Name von KNAPP umfasst mehrere Gesellschaften, die Buchenwälder Ungarns und der Karpaten keinesfalls. Die westdeutschen Soziologen, wie K. HARTM. 59, TÜXEN 60, OBERDORFER 67—70 verstehen darunter das subatlantische artenarme, sog. *F. boreo-atlanticum* Tx. = *Melico-F.* em. Hartm., das nach Osten vielleicht bis NW-Böhmen und den Sudeten verbreitet ist (NEUHÄUSL, MATUSZKIEWICZ usw.). Über weitere mitteleuropäische Buchenwälder vgl. SOÓ 71: *Dentario bulbifero-F.* Hartm. 53 em. Lohm. 62, *Asperulo-F.* H. Mayer 64, Müller 66 = *Carici-F.* Oberd. 1957, *Lathyro-F.* Hartm. 1953 usw. Diesen gegenüber sind für das *Melittio-F.* als Hauptass. bezeichnend: *Quercus cerris*, *Dactylorhiza fuchsii* subsp. *sooiana*, *Daphne laureola*, *Dentaria glandulosa*, *Festuca drymeia*, *Galium schultesii*, *Helleborus purpurascens*, *Isopyrum*, *Knautia drymeia*, *Lathyrus transsilvanicus*, *Scopolia*, *Waldsteinia geoides*, usw., auch einige *Fagion illyricum* Arten und eindringende südostliche Eichenwaldarten (s. die Tabelle). Vgl. noch SOÓ Zönosyst, Bemerkungen 64. Sonst ist das System der mitteleuropäischen, Buchenwälder bei den verschiedenen Autoren auch heute voneinander ziemlich abweichend, so z. B. bei OBERDORFER 67—70, HARTMANN—JAHN 67, PASSARGE 68, H. MAYER 73 usw.

Als Grundeinheit der Syntaxonomie oder Zönosystematik wird heutzutage immer mehr die regionale oder territoriale Ass. aufgefasst, die mit Kenn- und Trennarten gekennzeichnet wird (vgl. OBERDORFER in TÜXEN Pflanzensoziologische Systematik 68, 124—141). Um diesem Kriterium zu entsprechen, werden die Kennarten der Gebietsass.-nen oft ganz lokal oder regional aufgefasst, so auch von mir seit etwa 15 Jahren. Viele dagegen halten das Vorkommen der Kennarten für die Abtrennung einer Ass. für unnötig. So arbeitet z. B. die ostdeutsche SCAMONI-PASSARGE Schule mit den sog. soziologischen Gruppen und verzichtet auf den Begriff der Charakterart. Meinerseits halte ich auch die Gesamtstruktur und Synökologie der Phytozoenosen für wichtig. Dagegen führen aber rein statistisch-mathematische Vergleiche der gemeinsamen bzw. fehlenden Arten, ohne ihre Dominanz, ökologische (Indikator-) Bedeutung, qualitative Wichtigkeit (Kenn- bzw. Trennart) usw. zu Fehlschlüssen. So wurden z. B. typische basiphile und azidophile Steppengesellschaften aufgrund der zahlreichen gemeinsamen psammophilen Begleiter, sogar Unkräuter miteinander identifiziert, oder die charakteristischen Karstbuschwälder auf Kalk und Andesit, Schluchtwälder auf Kalk und Andesit vereinigt usw. Leider werden kürzlich diese sog. »objektiven Methoden« auch in der ungarischen Phytozönologie als allein seligmachende verkündigt (SIMON 72—73), vgl. richtige Auffassung: SPATZ—SIEGMUND: Vegetatio **28,** 1973).

Wir bleiben den Begriffen und der Methodik der Schule von BRAUN-BLANQUET (»Zürich-Montpellier«) treu, wenn wir auch den Begriff »Hauptassoziation« (KNAPP) etwa im Sinne der »Assoziationsgruppe« von PASSARGE (nicht TÜXEN oder OBERDORFER) für nützlich halten. Die regionalen Ass.-nen sollen neuerdings mit Doppelnamen bezeichnet werden, geographische Attribute (wie medio-europaeum, pannonicum, carpaticum, noricum) sind zu vermeiden bzw. dürfen nur für die geographischen Varianten (»Rassen«) gebraucht werden. Deshalb musste ich den regionalen Ass.-nen des *Melittio-Fagetum* neue Doppelnamen geben, wie das sonst in der mitteleuropäischen Literatur üblich ist. Meiner Meinung nach ist der Name einer Assoziation gültig, wenn die charakteristische Artenkombination im klassischen Sinne (so BRAUN-BLANQUET Pflanzensoziologie 1928 : 60) angegeben ist, diesem Prinzip folgte fast bis heute die ungarische Schule (»Debrecen«). Natürlich sind synthetische Listen (zuerst bei mir 27) und noch mehr volle Tabellen wertvoller. Aber auch die Stetigkeitsliste genügt (vgl. RAUSCHERT Vegetatio **25** : 283 ff. 1972) als »nomenklatorischer Typus«. Der Autorenname ist in allen diesen Fällen gültig. Bei nomina nuda soll der Autor eventuell in Klammer erwähnt werden, im Falle der Reinbestände (z. B. Wasserpflanzensoziationen) genügt wohl auch der Name.

Und noch etwas nomenklatorisches: es ist grammatisch unrichtig, wenn man in zusammengesetzten Gesellschaftsnamen den Speziesnamen in Genitiv

stellt (wie das jetzt allgemein üblich ist) und nicht richtig in Dativ. Z. B. *Querco robori-Carpinetum* (*Querceto roboris-Carpinetum* war richtig, denn bei den Ass.-snamen bedeutete das eine wohlbekannte Abkürzung, so *Quercetum roboris* statt *Q. Quercus roboris* oder *Fagetum sylvaticae* bedeutet *Fagetum Fagi sylvaticae*, aber ein *Querco* (*Q.*) *roboris-Carpinetum* ist unmöglich.

Übersicht der behandelten Buchenwälder

Klasse: **CARPINO-FAGETEA** Jakucs 60

Ordnung: FAGETALIA SYLVATICAE Pawl. 28 emend.

Verband: **Fagion medio-europaeum** Soó (Syn. s. oben)

Unterverband: *Asperulo-Fagion* (Knapp 42) Tx. 55
(Eu-*Fagion* Oberd. 57)

1. **Aconito-Fagetum** Soó (30 als Fazies) 60, 62 T, 64 T

Syn.: *Fag. sylv. altherbosum* Soó et Zólyomi 51, *F. subcarpaticum* Soó 40, Zólyomi 54 nom. nuda, weitere in Soó 62, 64

Subass.: a) *festucetosum altissimae* Szujkó-Lacza 62, b) *galietosum odoratae* (*asperuletosum*), c) *oxalidetosum*, d) *mercurialidetosum* Pócs in Zólyomi 67, e) *prenanthetosum* Szujkó-Lacza 62

Oft hochstaudenreicher, montaner, reiner Buchenwald ohne Tanne, mit wenig Hainbuche. Nördliches Ungar. Mittelgebirge (Florenbezirk Matricum) und die Slowakei, meist zwischen (600) 750 und 1000 m

2. **Melittio-Fagetum** Soó 62 p.p., 64 p.p., 71 s. str.

Syn.: *Melitti-F. subcarpaticum* (Soó 40 »*M. subcarpaticum*« nom. nud.) 62 T, 64 T, *F. carpaticum* Dostál 33 T. p. maj. p., *Melico-F.* auct. hung. p. p., *slovacicum* Knapp 42, *subcarpaticum* Soó 57, *Dentario-F.* auct. slovac. p. p., so Neuhäuslová 1970, dort weitere Syn., so *Fagus silvatica-Dentaria bulbifera* Ass. Zlatnik 35 (non *Dentario bulbifero-F.* Hartm. 53, 67 aus Deutschland), *F. carpaticum submontanum* Klika 37, Neuhäusl 69, *F. typicum* Zlatnik 59, etc. *Violo sylvestri-F.* Szujkó-Lacza 65 ined.

Subass.: a) *galietosum odorati*, b) *oxalidetosum*, c) *caricetosum pilosae*, d) *melicetosum uniflorae*, e) »*nudum*« alle (Magyar 33 als Typen) Soó 62, f) *altherbosum*: *filicetosum* Soó (40) 62, g) *dicranetosum* Soó 62 (*Dicrano-F.* Szujkó-Lacza 62)

Submontaner Buchenmischwald des Nördl. Ungar. Mittelgebirges und der Slowakei, meist (240) 400—900 (1110) m, auch im Übergangsbezirk zu Bakonyicum (Szentendre-Visegráder Gebirge)

3. **Laureolae-Fagetum** Soó 71 73

Syn.: *Melitti-F. hungaricum* Soó 62 T, 64 T, *Melico-F. hungaricum* Soó 57, *Fag. hungaricum* Soó 34 p. p. et auct. hung., *Fag. silvaticae* Soó 1930—31 T

Subass.: a) *galietosum odorati* b) *oxalidetosum*, c) *caricetosum pilosae*, d) *melicetosum uniflorae*, e) »*nudum*«, f) *altherbosum*, g) *aegopodietosum* Soó hoc loco (zuerst meist von Soó 30—31, MAGYAR 36, MAJER 52 als Typen erwähnt)

Submontaner Buchenmischwald des Westlichen Ungar. Mittelgebirges (Florenbezirk Bakonyicum) vom Pilis-Budaer Gebirge bis zum Balatongebiet. 200—700 m

4. **Cyclamini-Fagetum** Soó 71,73

Syn.: *Melitti-F. noricum* Soó 62 T, 64 T, *Fag. noricum* Soó 34, *Fag. praenoricum* Soó—Zólyomi 51, dagegen nicht *Melico-F. medio-stiriacum* Knapp 44 emend. Eggler 53 (dieses ist z. T. *Abieti-Fagetum*, z. T. »*Luzulo-Fagetum*«, z. T. *Seslerio-Fagetum*), *Melico-F. austriacum* Knapp 42 p. p., *F. altovindobonense typicum* Knapp 44 p. p., *allietosum* Knapp 44 p. p., *F. boreo-noricum* Knapp 44 p. maj. p. etc.

Subass.: a) *galietosum odorati*, b) *oxalidetosum*, c) *caricetosum pilosae*, d) *melicetosum uniflorae*, e) *festucetosum altissimae* (VIDA in Soó), f) *altherbosum* (zuerst meist von Soó und MAGYAR als Typen aufgezählt)

Submontaner Buchenmischwald in West-Transdanubien, Burgenland, Niederösterreich!, wohl auch in Steiermark. 200—500 m

Charakterarten bzw. regionale Kenn- u. Trennarten der 4 Ass. wurden in der Tabelle, die Fazies in den Erklärungen aufgezählt.

1. Bemerkungen zur syntaxonomischen bzw. zoenosystematischen Rolle der einzelnen Arten. (Übersicht im III. Bd. meiner Synopsis, p. F. 11—71)

Unter den regionalen Kenn-u. Trennarten der behandelten Assoziationen sind im allgemeinen mehr oder minder *Acerion* (*pseudoplatani*) Arten: *Ribes alpinum*, *Clematis alpina* (auch *Cephal.-Fagion*), *Hesperis matronalis* agg., *Lunaria rediviva*, *Pleurospermum*, *Anthriscus nitida*, *Scutellaria columnae*, *Stellaria nemorum* (auch *Alno-Padion*). *Filipendulo-Petasition* Arten: *Orobanche flava*, *Doronicum austriacum*; manche *Pino-Quercetalia*, z. B. *Galium rotundifolium*, *Hypericum maculatum*, *Thelypteris limbosperma*, *Orno Cotinion* Arten: *Fraxinus ornus* (in Übergangsbeständen zu *Fago-Ornetum* auch *Coronilla emerus*, die einzige Charakterart des *Fagion dacicum* ist *Lathyrus transsilvanicus*. Die meisten sind doch allgemeine *Fagetalia* bzw. *Asperulo-Fagion* Arten. Einige *Fagetalia* Arten gehen in die *Abieti-Piceion* Wälder über, so z. B. *Cyclamen*, *Dryopteris dilatata*, *Oxalis*, *Petasites albus*, *Sorbus aucuparia* etc., andere in die *Epilobietea*, so. z. B. *Rubus hirtus* agg., *Senecio nemorensis*, dagegen sind einige Taxa, die mit gleichem Recht als *Fagetalia* bzw. *Querco-Fagea* (vor allem *Carpino-Fagetea*) Arten aufzufassen sind, wie *Acer platanoides*, *Geranium robertianum*, *Moehringia trinervia*, *Mycelis*, manche *Querco-Fagea* Arten sind auch in *Pino-Quercetalis* gleich verbreitet (z. B. *Festuca heterophylla*, *Hieracium sylvaticum*). *Calluna* ist natürlich *Calluno-Genistion* Charakterart. *Arum maculatum* auct. p. max. p.: *A. alpinum*, *A. maculatum* vielleicht in *Laureolae-Fagetum*

2. Unbedeutende akzidentelle Arten:

Melittio-F.: *Achillea millefolium* agg., *Clematis integrifolia*, *Colchicum autumnale*, *Cynoglossum hungaricum*, *Epilobium hirsutum*, *Leucanthemum vulgare* agg., *Petasites hybridus*, *Physalis*, *Potentilla erecta*,? *Sorbus domestica*

Laureolae-F.: *Coronilla varia*, *Inula conyza*, *Pimpinella saxifraga* agg., *Sagina procumbens*, *Trifolium arvense*

Querco cerri-Luzulo-F.: *Anthoxanthum*, *Verbascum thapsus*

Galio rotundifolio-F.: *Centaurium erythrea*, *Filipendula ulmaria*, etc.

3. Erklärung der Tabelle.

a) *Aconito-Fagetum*

1. col. Sátor- o. Zempliner Gebirge. 8 Aufn. ovn T. SIMON in Soó 62.
Faziesbildend: *Galium odoratum*, *Carex pilosa*, *Festuca altissima*, *Dentaria glandulosa*. 600—880 m.
2. col. Bükk-Gebirge 25 Aufn. von T. PÓCS in Soó 62, ergänzt mit 5 PÓCS in ZÓLYOMI 67 sowie mit Angaben von Soó (30). Faziesbildend: *Oxalis*, *Galium odoratum*, *Mercurialis perennis*, *Festuca altissima* (diese vier nach PÓCS bilden ökologische Subass.), *Hordelymus*, *Senecio nemorensis* ssp. *fuchsii*, *Aegopodium*, selten *Hesperis matronalis* ssp. *vrabelyiana*, *Aconitum variegatum* ssp. *gracile*. 700—950 m.
3. col. Mátra-Gebirge. 7 Aufn. von J. SZUJKÓ-LACZA 62 (no. 4—10)
Faziesbildend:*Oxalis*, *Galium odoratum*, *Mercurialis*, *Carex pilosa*, in der typischen Subass. (»*festucetosum altissimae*« Szujkó-Lacza), in der hygrophilen hochstaudenreichen Subass. *prenanthetosum* Szujkó-Lacza 62 die Arten *Petasites albus*, *Lunaria rediviva*, *Senecio nemorensis* agg. 900—1010 m
4. col. Börzsöny-Gebirge. 10 Aufn. von J. SZUJKÓ-LACZA 65 diss. ined. (3 schon 62 no. 1—3 publiziert)
Faziesbildend: *Oxalis*, *Galium odoratum*, *Mercurialis*, *Lamium galeobdolon*, ferner (s. col. 3.) *Petasites albus*, *Lunaria rediviva*. 940 m

2) *Melittio-Fagetum* (*subcarpaticum*)

5. col. Sátor bzw. Zempliner Gebirge. 5 Aufn. von T. SIMON in Soó 62
Faziesbildend: *Galium odoratum*, *Carex pilosa*, *Melica uniflora*. 400—550 m
6. col. Bükk-Gebirge. 20 Aufn. von VIDA in Soó 62 bzw. VIDA u. PÓCS in ZÓLYOMI 67
Ökologische Subass.: *galietosum odorati* (*asperuletosum*) auf Kalkrendzina, *caricetosum pilosae* auf Braunerde, *Melicetosum uniflorae* auf Quarzit bildender Parabraunerde (vgl. Soó 62, VIDA—PÓCS 1. c.) Faziesbildende Arten ausserdem *Helleborus purpurascens*, *Stellaria holostea*, *Impatiens*, *Aegopodium*, *Majanthemum* usw. (300) 400—750 m.
7. col. Mátra u. Börzsöny Gebirge. 37 Aufn. von J. SZUJKÓ-LACZA 62 (davon 10 der *Carpinus*-Konsoziation), ergänzt mit Angaben von Soó und M. KOVÁCS in Soó 62, ferner 5 Aufn. von M. KOVÁCS 64.
Faziesbildend: *Oxalis*, *Galium odoratum*, *Carex pilosa*, *Poa nemoralis*, *Dentaria bulbifera*, sekundärer Typ nudum. 240—1010 m
8. col. Börzsöny-Gebirge, 25 Aufn. von J. SZUJKÓ-LACZA 65 ined.
Faziesbildend (bzw. Subass. wie in col. 6.) *Galium odoratum*, *Carex pilosa*, *Oxalis*, *Poa nemoralis*, *Dentaria bulbifera*. 315—865 m
9. col. Mátra u. Börzsöny-Gebirge. 5 Aufn. v. J. SZUJKÓ-LACZA 62, 65 als *Dicrano-Fagetum*, die Subass. *dicranetosum*. 470—1110 m
10. col. Szentendre-Visegráder Gebirge. 11 Aufn. von HORÁNSZKY in Soó 62 bzw. HORÁNSZKY 64
Faziesbildend: *Galium odoratum*, *Carex pilosa*, *Melica uniflora*. (260) 400—500 m

3) *Laureolae-Fagetum* (*Melittio-F. hungaricum*)

11. col. Budaer Gebirge. 16 Aufn. von ZÓLYOMI 58, aber nach der unveröffentlichten vollständigen Tabelle
Faziesbildend: *Galium odoratum*, *Melica uniflora*, *Mercurialis*, *Aegopodium*, sogar *Hedera*. 290—550 m
12. col. Vértes-Gebirge. 10 Aufn. von I. ISÉPY 70
Subass.: *caricetosum pilosae* und *galietosum odorati* (»*asperuletosum*«), faziesbildend noch *Mercurialis*, *Dentaria bulbifera*. Bis etwa 600 m.
13. col. Vértes-Gebirge. 35 Aufn. von Z. SZÖCS (66), verkürzte Tabelle 71
Faziesbildend (bzw. Subass., wie früher): *Galium odoratum*, *Lamium galeobdolon*, *Carex pilosa*, *Melica uniflora*, *Mercurialis*, seltener *Aegopodium*, (*Circaea*, *Viola sylvestris*), kulturbeeinflusst: *Parietaria erecta*, *Urtica dioica*. 270—460 m
14. col. Bakony-Gebirge. 32 Aufn. von G. FEKETE in Soó 62 Eine Subass. *oxalidetosum* (reines *Fagetum*) entspricht zonal dem *Aconito-F.*, ohne dessen Kennarten. Weitere Fazies von *Allium ursinum* (mehr Frühlingsaspekt), *Galium odoratum*, *Carex pilosa*, *Melica uniflora*, *Dentaria bulbifera*, *Aegopodium*. 200—700 m

15. col. Bakony-Gebirge. 8 Bestandesaufn. von Soó (30) Fazies von *Oxalis-Galium odoratum*, *Oxalis-Luzula albida*, *Galium odoratum*, *Mercurialis*, *Melica uniflora*, *Poa nemoralis*, *Circaea*, degradierte *Urtica* mit *Geranium phaeum*. 300—700 m (Originalaufnahmen verloren)
16. col. Balatongegend. 8 Bestandesaufnahmen von Soó (29—30)
Faziesbildend: *Allium ursinum* (vgl. col. 14), *Galium odoratum*, *Hedera*, *Circaea*, *Brachypodium sylvaticum*, degradierter Typ *Glechoma hirsuta*, *Lamium maculatum*. Die Bestände stark kultureinflusst, z. T. in *Querco petraeae-Carpinetum* übergehend.

4) *Cyclamini-Fagetum* (*Melittio-F. noricum*)

17. col. Soproner Gebirge. 15 Aufn. von Soó (42) *Carpinus* Konsoziation, (»*Carpinetum betuli*« a. *asperulosum*, b. *melicosum*, e. *normale* Soó 1942) Sekundäre Bestände an der Stelle einstiger Buchenwälder
Subass.: a. *galietosum odorati*, b. *melicetosum uniflorae*, e.*caricetosum pilosae* mit Fazies von *Dactylis polygama*, *Poa nemoralis*, *Carex sylvatica*, *Luzula albida*. 300—400 m
18. col. Kőszeger Gebirge. 5 Aufn. von VIDA in Soó 62 (subass. *festucetosum altissimae*), ergänzt mit Angaben von Soó (33) aus anderen Typen. Nur Präsenzwerte (!). Die Buchenwälder des Gebirges gehören sonst entweder zum *Abieti-Fagetum* Knapp *orienti-alpinum* Knapp 1942 (*noricum* Soó 1957), aber nur jenseits der Landesgrenze im Burgenland oder, die azidophilen, zum *Galio rotundifolio-Fagetum* Soó (34) 71, s. unten.
19. col. Windisches Gebiet und Őrség in SW Ungarn. 8 Aufn. von Pócs in Soó 62
Faziesbildend: *Oxalis*, *Galium odoratum*, *Carex pilosa*. 210—310 m. Weiter gegen Südosten treten schon die Assoziationen des *Fagion illyricum* auf: *Vicio oroboidi-Fagetum* Pócs et Borhidi 60 (geographische Varianten: *saladiense* u. *somogyicum*), *Helleboro-odoro-F.* Soó et Borhidi 60, geogr. Var.: *mecsekense* (Horvát 58) Soó et Borhidi 62 s. S. 355.

Zum Vergleich:

Klasse: **QUERCETEA ROBORI-PETRAEAE** Br.-Bl. et Tx. 43

Ordnung: PINO-QUERCETALIA Soó 62

Verband: **Deschampsio-Fagion** Soó 62, 64 (*Luzulo-Fagion* Lomh. et Tx. 54 p. p. als Verband o. Unterverband der *Fagetalia*, s. oben*

Castaneo-Quercion Soó 62, 61 mit *Castaneo-Quercetum* I. Horvat 38 (Ostalpen, Transdanubien, N-Jugoslawien) und *Luzulo-Querco-Carpinetum* Soó 57 (T. in CSAPODY 64) ebenfalls

Genisto germanicae-Quercion Neuhäusl et Neuhäuslová 67 mit *Genisto tinctoriae-Q.* Klika 32 (p. p.) emend. Soó 63 (das älteste *Luzulo-Q.* Hilitzer 32) als Hauptass., dazu als regionale Ass.-en in der Slowakei und in Nordungarn *Chrysanthemo corymboso-Luzulo-Quercetum* (Magyar 33) Soó 71 (*Gentisto tinctoriae-Q. subcarpaticum* Soó [40/62]) und *Genisto-Querco-Carpinetum* Soó 71 (*Luzulo-Querco-Carpinetum subcarpaticum* Soó 57)

Pino-Quercion Medwecka-Kornaś—Kornaś—Pawl. 59, dazu gehören aus Westungarn die noch nicht vollständig publizierten *Genisto nervatae-Pinetum* Pócs 66 und *Aulacomnio-Pinetum* Pócs 66

* Darin die Charakterarten des *Quercion roboris-petraeae* Br.-Bl. 32, wie *Lonicera periclymenum*, *Ilex aquifolium*, *Hypericum pulchrum*, ferner z. B. *Digitalis purpurea*, *Carex pilulifera*, *Festuca ovina* s. str., *Trientalis* usw. Meiner Ansicht nach gehört auch der Verband *Luzulo-Fagion* in die Ordnung *Quercetalia robori-petraeae* Tx. 31. Zur Ordnung *Pino-Quercetalia* möchten wir dagegen die ost- und südost-mitteleuropäischen azidophilen Eichen- und Kiefernmischwälder ziehen (meist auch unter *Luzulo-Quercetum* beschrieben), und zwar:

Querco cerri-Luzulo-Fagetum (Magyar 1933) Soó 71, 73 nom. nov.

Syn.: *Fagus sylvatica Luzulo nemorosa u. Vaccinium myrtillus* Soz. Magyar 33, *Luzulo-Fagetum* auct. slovac., etiam Neuhäusl 69, *Luzulo-F. subcarpaticum* Zólyomi 55, *Luzulo-Q. subcarpaticum fagetosum* Zólyomi 54, Kovács 64 T, *Deschampsio-Fagetum* Soó 62 — non Br.-Bl. 55, nec Passarge 56—*subcarpaticum* Soó 62, 64, Szujkó-Lacza 62 T. *Hieracio-F.* Lacza 65 ined. T. non aliorum

Azidophiler Buchenwald des Nördl. Ungar. Mittelgebirges und der Slowakei 400—650 m

20. col. Börzsöny-Geb. (10 Aufn. v. J. SZUJKÓ-LACZA 62 u. 65 ined.)

Galio rotundifolio-Fagetum Soó 71, 73 nom. nov.

Syn.: *Fag. noricum* Soó 34, *F. praenoricum* Soó et Zólyomi 51 p. p., *F. altovindobonense* et *mediostiriacum* Knapp 44 *polytrichetosum* Knapp 44, *F. myrtilletosum* et *luzulinum* Majer 52, *Fagus sylv.-Luzula nemorosa* Ass. Felföldy 51, *Carpinetum luzuletosum* et *myrtilletosum* Soó 42 T, *Querceto-Luzuletum noricum fagetosum* Orlóczy et Tuskó 55, *Luzulo-F.* auct. hung., *noricum* Soó 57, *Deschampsio flexuosae-Fagetum* Soó non alior., *noricum* Soó 62, Csapody 64 T, Jeanplong 70 L

Azidophiler Buchenwald im Westl. Ungar. Mittelgebirge (Bakony, Balatongebiet), West-Transdanubien, Burgenland, Niederösterreich !, Steiermark.

21. col. Soproner Gebirge (16 Aufn. von CSAPODY 64 T. 330—470 m)
Subass.: *luzuletosum albidae*, *nudum* (meist *Picea*-Kultur.-Konsoz.), *myrtilletosum* Csapody incl. *Plagiothecium*-Fazies.

22. col. Soproner Gebirge 10 Aufn. von Soó *Carpinus* Konsoziation («*Carpinetum betuli*« c. *luzuletosum*, d. *myrtilletosum* Soó 42) Sekundäre Bestände an der Stelle einstiger Buchenwälder. Subass. *luzuletosum albidae* und *myrtilletosum*, selten faziesbildend *Galium odoratum*. 320 m. Dazu 3 Aufn. von FEHÉR u. KISS (32) II. 2. Tab. *Carpinus* Konsoz. u. II. 3. Tab. 1.

Für diese *Deschampsio-Fagion* Gesellschaften sind *Querco-Fagea* und *Pino-Quercetalia* Arten südlichen und östlichen Charakters bezeichnend, vgl. Soó 71 : 167, 73: 609—10, über Subass. in Soó Syn. 1: 265, 1964

Die von mir 42 beschriebenen Gesellschaften: *Piceetum excelsae carpinoso-quercetum* (mit Fazies *melicosum uniflorae*, *hypnosum cupressiformis* und *muscosum*) sind Fichtenforste mit gemischtem Unterwuchs wohl Kulturkonsoz. des *Luzulo-Querco-Carpinetum* Soó 57 (*noricum*), Csapody 64 Tab. (Subass.: *luzuletosum*, *deschampsietosum*, *myrtilletosum*); *Piceetum excelsae subnudum* dagegen ein Fichtenforst an Stelle eines *Cyclamini-Fagetum* (darin auch *Epipactis purpurata*)

Ebenso nicht aufgenommen wurde der von FELFÖLDY u. Mitarbeiter (52) beschriebene Buchenwald aus der Balatongegend (Tab. II.) z. T. ein Übergang des *Fago-Ornetum* zum *Laureolae-Fagetum* (mit *Coronilla emerus*, *Epipactis microphylla*, *Galium austriacum*, als *pumilum* falschbestimmt) col. 5—6 ist typisches *Fago-Ornetum* mit *Carex alba*.

23. col. Zu *Galio-F.* gehören 3 Aufn. von HÜBL aus dem (1959) Leithagebirge Tab. von *Querco-Carpinetum* Subass. von *Luzula luzuloides* No. 8, von *Querco-Potentilletum albae* No. 23, 24, die anderen Aufnahmen z. T. zu *Luzulo-Querco-Carpinetum* Soó 57 (*noricum* Soó

[(34)57], cf. Soó ABH **8**: 340 (62) bzw. zu *Castaneo-Quercetum* I. Horvat 38 em. Soó *noricum* Soó (33) 62; in Soó l. c. 338 fehlt als Synonym *Querco-Potentilletum albae* Hübl 1959 non Libbert. Auch *Carex pilosa* Fazies. 350—420 m
Das *Querco-Carpinetum* Subass. von *Fagus sylvatica* Hübl, 1959 ist ein *Castaneo-Querco-Carpinetum* Soó (34) 71 [*Q.petraea-Carp. transdanubicum* Soó et Zólyomi (50) 57, Csapody 64 Tab.], vgl. Soó ABH **8**: 355, **17**: 162, bes. *caricetosum pilosae* und *galietosum odorati*, oder aber sekundäre *Carpinus* Kons. des *Cyclamini-Fagetum* (Variante von *Anemone ranunculoides*, col. 1—7). Ebenso vielleicht *Qu.-Carp.* Subass. von *Sorbus torminalis* (nicht bezeichnend) Subvariante von *Fagus sylvatica*, aber ohne *Cyclamini-F.* Arten, mehr *Qu.-Carp.*

Sehr schwer zu beurteilen sind die 1944 publizierten Tabellen (in Vervielfältigung) von KNAPP. Einige davon gehören wohl z. T. zu *Cyclamini-F.*, z. T. zu *Galio rotundifolio-F.* (vgl. oben die Synonyme dieser Ass.), grösstenteils aber zu Hauptassoziation des *Abieti-Fagetum* Knapp 42 (der Name stammt zuerst von BERTSCH). Inzwischen wurde eine grosse Reihe verschiedener regionaler *Abieti-F.* beschrieben (vgl. die oben zitierten neuen Arbeiten von OBERDORFER 67—70, HARTMANN-JAHN 67, PASSARGE 68, H. MAYER 73 usw.), da aber Tannen-Buchenwälder nur jenseits der ungarischen Staatsgrenze in den Ostalpen auftreten, will ich mich hier nicht mit diesen Phytozoenosen beschäftigen. Ebensowenig mit dem System der Laubwälder der ostdeutschen Schule, die z. B. so nahe Gesellschaften, wie die mehr oder weniger azidophilen bzw. azidoklinen *Vaccinium myrtillus* und *Luzula albida* Buchenwälder in verschiedene Verbände, Ordnungen, sogar Klassen einteilt (vgl. die neueste Übersicht in der Exkursionsflora von ROTHMALER—MEUSEL—SCHUBERT 1972).

Nachtrag

Erst nach dem Abschluss meiner Arbeit erhielt ich durch die Güte von Herrn Prof. E. HÜBL einige Publikationen der Wiener Forstlichen Versuchsanstalt. Diese wertvollen synökologisch-waldbaulichen Arbeiten enthalten meist Beschreibungen von Waldtypen ohne soziologische Benennung und Tabellen. Erst JELEM (1969) gibt eine vergleichende Tabelle, nachdem sein *Melampyrum pratense- Hieracium sabaudum- Calamagrostis arundinacea* Buchenwald meinem *Galio rotundifolio-Fagetum*, sein *Carex pilosa-Asperula odorata-Lathyrus vernus* Buchenwald meinem *Cyclamini-Fagetum* entspricht. (Daraus weitere Kennarten: *Helleborus viridis*, *Ranunculus nemorosus* usw.)

Ausführliche Tabellen findet man im neuesten Werk von ZUKRIGL (1973). Aber auch seine sog. submontanen Buchenwälder mit Tanne, Fichte, Lärche gehören zu den *Abieti-Fagetum*, wenn auch sein »*Luzulo-Fagetum*« unserem *Galio rotundifolio-F.* (darin auch *Hieracium transsylvanicum*, *H. praecurrens*), sein »*Asperulo-Fagetum*« unserem *Cyclamini-F.* nahe steht. Gute regionale Kalk-Buchenmischwald-Assoziationen sind das steierische *Poo stiriaco-Fagetum* (incl. *Poo stiriaco-Abieti-Fagetum*) —darin konstant *Cyclamen*, *Daphne mezereum*, Kennarten z. B. noch *Pulmonaria stiriaca*, *Peltaria*, *Chamaebuxus*, *Vicia oroboides*, *Senecio ovirensis* usw. — und das *Helleboro* (*nigro* !) - *Fagetum* der Nördlichen Kalkalpen (incl. *Helleboro-Abieti-Fagetum*) mit vielen kennzeichnenden Arten, auch mit konstantem *Cyclamen*, aber sonst mit ganz anderer Zusammensetzung (Unterwuchs von *Carex alba*, *Calamagrostis varia*, *Luzula*-Arten usw.). Diese beiden Ass.-nen gehören zum Unterverband *Daphno-Fagion* Th. Müll. 66, deren Existenz aber von OBERDORFER et al. (67, p. 58) bezweifelt wurde.

Es ist zu bedauern, dass die Wiener Forstbotaniker (H. MAYER u. seine Schule) die Bedeutung der Kenn- und Trennarten nicht anerkennen, sowie, dass ihm eben meine wichtigsten Buchenwaldarbeiten (Lit. 1., 2.) unbekannt geblieben sind.

Tabelle

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Kenn- u. Trennarten									
v. Aconito-Fagetum									
Ribes alpinum	(I)	I	–	–	–	–	–	–	–
Rosa pendulina	(I)	I	I	I	–	–	–	–	+
Aconitum moldavicum	(!)	I	–	–	–	–	–	–	–
A. varieg. ssp. *gracile*	(I)	I	+	–	–	–	–	–	–
Clematis alpina	–	+	I	I	–	–	–	–	–
Dentaria glandulosa	III	–	–	–	I	–	–	–	–
Geum aleppicum	–	+	–	–	–	–	–	–	–
Hesperis matronalis ssp. *candida* et *vrabelyiana*	–	II	–	–	–	–	–	–	–
Lunaria rediviva	–	II	II	II	–	–	–	–	–
Orobanche flava				+					
Petasites albus	–	I	I	I	–	–	–	–	–
Pleurospermum austriacum	–	+	I	I	–	–	–	–	–
Polygonatum verticillatum	III	II	II	II	–	–	–	–	–
Valeriana sambucifolia	–	–	–	I	–	–	–	–	–
(Listera ovata)	I	–	–	–	–	–	–	–	–
v. Aconito- et Melittio-Fagetum									
Ribes uva-crispa	I	I	I	+	–	+	I	+	–
Astrantia major	II	–	–	–	–	I	+	–	–
Gymnocarpium dryopteris	–	I	–	–	I	–	I	I	IV
Waldsteinia geoides	I	–	–	–	–	I	–	–	–
v. Melittio-Fagetum									
Anthriscus nitida	–	–	–	–	–	I	–	–	–
Dactylor. fuchsii ssp. *sooiana*	–	–	–	–	–	I	–	–	–
(Epipactis purpurata)	–	–	–	–	I	+	–	–	–
Helleborus purpurascens	–	I	–	–	–	III	–	–	–
Lathyrus transsilvanicus	–	–	–	–	–	+	–	–	–
Primula elatior	–	–	–	–	–	+	+	–	–
Scopolia carniolica	–	–	–	–	–	I	I	–	–
Stachys alpina	–	–	–	–	–	–	+	–	–
Trifolium medium ssp. *sarosiense*	–	–	–	–	–	I	–	–	–
v. = Laureolae-Fagetum									
Allium ursinum	–	–	–	–	–	–	–	–	–
Daphne laureola	–	–	–	–	–	–	–	–	–
Corydalis intermedia	–	–	–	–	–	–	–	–	–
(Hepatica nobilis)	–	–	–	–	–	–	–	–	–
Hieracium wiesbaurianum	–	–	–	–	–	–	–	–	–
Scutellaria columnae	–	–	–	–	–	–	–	–	–
v. Laureolae-F. u. Fagion illyricum									
Fraxinus ornus	–	–	–	–	–	–	–	–	–
Dentaria enneaphyllos	–	–	–	–	–	–	–	–	–
Galium sylvaticum	–	–	–	–	–	–	–	–	–
Knautia drymeia	–	–	–	–	–	–	–	–	–
Luzula forsteri	–	–	–	–	–	–	–	–	–
Lathyrus venetus	–	–	–	–	–	–	–	–	–
Primula vulgaris	–	–	–	–	–	–	–	–	–
Tamus communis	–	–	–	–	–	–	–	–	–
Veratrum nigrum	–	–	–	–	–	–	–	–	–
v. Cyclamini-Fagetum									
Cardamine trifolia	–	–	–	–	–	–	–	–	–
Cyclamen purpurascens	–	–	–	–	–	–	–	–	–
Doronicum austriacum	–	–	–	–	–	–	–	–	–
Dryopteris pseudomas	–	–	–	–	–	–	–	–	–
Galium rotundifolium	–	–	–	–	–	–	–	–	–

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
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	1.	2.	3.	4.	5.	6.	7.	8.	9.
Gentiana asclepiadea	—	—	—	—	—	—	—	—	—
Hypericum maculatum (ssp.)	—	—	—	—	—	—	—	—	—
Luzula pilosa	—	—	—	—	—	—	—	—	—
Phyteuma spicatum	—	—	—	—	—	—	—	—	—
Stellaria nemorum	—	—	—	—	—	—	—	—	—
Thelypteris limbosperma	—	—	—	—	—	—	—	—	—
v. Fagetalia (incl. **Asperulo-Fagion**)									
Fagus sylvatica	V	V	V	V	V	V	V	V	V
Ulmus glabra (scabra)	III-	II-	I	+	—	II	I	—	II
Aconitum vulparia	—	—	I	+	—	I	I	—	—
Actaea spicata	III-	II	III	I	I	I	I	I	—
Adoxa moschatellina	—	I	—	—	—	—	—	—	—
Aegopodium podagraria	II	III	I	+	—	IV	I	I	II
Anemone nemorosa	I	—	—	—	I	—	—	—	—
A. ranunculoides	IV	—	I	—	I	—	I	+	—
Asarum europaeum	—	—	—	+	I	I	I	—	—
Campanula trachelium	III	I	—	.	II	I	I	I	I
Cardamine impatiens	II	I	—	—	I	I	I	+	—
Carex sylvatica	—	I	—	—	—	—	—	—	—
Circaea lutetiana	—	I	—	—	I	I	I	+	—
Corydalis cava	II	—	I	+	—	—	—	—	—
C. solida	I	—	I	+	—	—	I	—	—
Daphne mezereum	II	II	I	+	—	II	I	I	II
Dentaria bulbifera	IV	IV	I	+	—	IV	I	I	—
Dryopteris dilatata	—	I	—	—	—	—	—	—	—
Euphorbia amygdaloides	V	II	I	+	III	III	II	I	—
Festuca altissima	I	I	III	III	—	II	—	—	—
F. drymeia	I	—	—	—	II	—	—	—	—
Gagea lutea	I	—	+	—	—	—	—	—	—
Galanthus nivalis	II	—	—	—	—	—	+	—	—
Galeobdolon luteum	II	II	IV	—	I	I	III	II	III
Galium odoratum	V	V	V	IV	I	IV	V	IV	II
Geranium phaeum	—	II	—	—	—	II	I	—	—
Glechoma hirsuta	V	V	I	+	II	IV	I	I	+
Hedera helix	—	I	I	+	—	II	I	I	—
Hordelymus europaeus	I	III	—	—	—	III	+	—	—
Isopyrum thalictroides	IV	I	—	II	I	I	III	I	—
Lamium maculatum	II	I	—	IV	I	I	—	—	I
Lathraea squamaria	—	—	—	—	—	—	—	—	—
Lathyrus vernus	III	I	I	I	II	IV	III	I	—
Lilium martagon	I	I	I	I	—	II	I	I	—
Mercurialis perennis	III	IV	V	V	—	IV	III	II	II
Milium effusum	IV	III	I	I	I	II	I	I	I
Myosotis sylvatica	—	III	I	+	—	—	—	—	—
Omphalodes scorpioides	—	I	—	—	—	—	—	—	—
Oxalis acetosella	IV	III	III	III	I	II	II	II	II
Paris quadrifolia	IV	I	I	—	I	+	I	I	—
Pulmonaria officinalis	V	IV	—	—	I	IV	I	I	I
Ranunculus lanuginosus	—	—	II	—	—	—	I	—	—
Rubus hirtus agg.	III-	—	—	—	I	I	I	—	—
Salvia glutinosa	III-	—	—	—	I	—	I	—	I
Sanicula europaea	—	II	—	—	I	II	II	I	I
Scrophularia vernalis	—	I	—	—	—	I	—	—	—
Stachys sylvatica	II	V	II	II	II	II	I	+	—
Senecio nemorensis *p. p. ssp. *fuchsii*	—	I	III*	III	—	I	III	I	I
Vicia sylvatica	—	—	—	—	—	—	—	—	—

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
—	—	—	—	—	—	—	—	!	I	—	(A)	—	—
—	—	—	—	—	—	—	—	!		—	—	—	—
—	—	—	—	—	—	—	I	!	III	—	—	—	—
—	—	—	—	—	—	—	I	—	—	II	—	—	—
—	—	—	—	—	—	—	—	—	I	—	—	—	—
—	—	—	—	—	—	—	—	!	I	—	(A)	—	—
V	V	V	V	V	V	V	+	!	V	V	V	II	!
II	—	—	II	III	III	II	—	—	—	—	—	—	—
—	II	—	I	I	II	I	—	—	II	—	—	—	—
—	I	—	I	I	III	I	I	—	II	—	—	—	—
—	—	—	I	—	—	—	—	—	II	—	—	—	—
—	II	—	I	II	III	I	I	!	II	—	—	—	—
—	—	—	—	—	—	—	I	!	III	—	—	—	—
—	III	III	III	I	—	I	—	—	—	—	—	—	—
II	V	II	—	I	I	I	—	—	II	—	—	—	—
I	I	II	I	II	III	I	I	—	I	—	—	I	—
I	—	—	—	—	II	I	I	—	—	+	—	—	—
+	I	—	I	II	I	I	III	!	II	—	—	II	—
+	I	—	II	II	III	II	—	—	—	+	—	—	—
—	IV	I	III	I	—	I	—	—	—	—	—	—	—
—	II	—	—	I	—	I	—	—	—	—	—	—	—
—	—	—	—	II	II	—	I	!	I	+	—	—	—
III	IV	IV	IV	V	III	I	I	!	—	II	—	+	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
I	IV	III	II-	IV	III	III	I	!	I	I	—	I	!
+	—	—	—	—	—	I	—	!	—	—	+	—	—
—	—	—	—	—	I	I	—	!	—	—	—	—	—
—	—	—	I	—	—	—	—	—	—	—	—	—	—
—	II	II	I-	I	—	III	—	—	—	—	—	—	—
III	III	II	IV	V	I	II	I	!	III	—	—	+	—
V	V	V	V	V	V	III	IV	!	V	II	+	I	!
—	—	—	—	I	IV	—	—	—	—	—	—	—	—
I	I	—	—	—	—	—	(I)	—	—	—	—	+	—
I	V	IV	III	III	I	III	—	—	II	—	—	—	—
+	I	II	III	II	—	—	—	—	—	—	—	—	—
I	I	—	I	II	—	—	—	—	I	—	—	—	—
I	I	I	—	I	IV	II	—	—	—	—	—	—	—
—	—	—	—	I	—	—	—	—	—	—	—	—	—
I	III	II	II-	V	I	II	II	!	III	II	I	—	!
—	V	I	I	II	—	I	I	—	I	+	—	—	—
II	V	V	II-	II	II	I	—	!	II	—	—	—	—
I	—	—	—	—	—	—	—	!	II	—	—	—	—
—	I	—	—	I	—	—	—	—	—	—	—	—	—
—	(I)	—	—	—	—	—	—	—	—	—	—	—	—
I	—	—	—	III	V	—	I	!	IV	II	II	+	—
—	—	—	—	I	II	—	I	!	I	—	—	—	—
I	V	IV	I	III	III	IV	II	!	IV	+	—	—	—
—	—	—	—	I	I	—	I	—	I	II	—	—	—
—	—	—	?	—	—	—	—	—	—	—	—	—	—
—	—	—	II-	II	III	III	—	!	II	—	—	—	—
III	II	II	—	IV	IV	III	II	—	III	—	+	—	!
—	—	—	—	—	I	—	—	—	—	—	—	—	—
II	II	—	II	II	II	II	I	—	I	—	—	+	—
—	—	—	—	I	—	—	II	!	—	—	—	III	—
—	—	—	—	—	I	—	—	—	—	—	—	—	—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
v. **Carpinion**									
Carpinus betulus	III	—	I	+	III	IV	V	II	—
Cerasus (*Prunus*) *avium*	II	I	—	—	—	—	I	I	—
Tilia cordata	—	—	—	—	—	+	I	I	+
Carex pilosa	III-	—	IV-	I	V	IV	IV	III	—
C. digitata	I	I	—	—	III	I	I	+	—
Melampyrum nemorosum	—	—	—	—	—	—	+	—	—
Stellaria holostea	II	II	II	—	—	IV	II	+	—
Vinca minor	—	—	—	—	I	—	—	—	—
v. **Acerion pseudoplatani**									
Acer pseudoplatanus	III-	V	III	III	—	III	II	—	II
Fraxinus excelsior	II	V	V	—	I	II	II	II	—
Tilia platyphyllos	I	—	—	—	—	I	I	—	+
Arabis turrita	—	I	—	—	—	—	—	—	—
Aruncus silvestris	—	—	—	—	—	—	—	—	—
Cystopteris fragilis	I	I	—	—	—	+	+	—	I
Phyllitis scolopendrium	—	—	—	—	—	+	—	—	—
Silene dioica	—	—	—	—	—	—	—	—	—
v. **Fagion** u. **Alno-Padion**									
Chrysosplenium alternif.	—	I	I	+	—	I	I	+	—
Carex remota	I	—	—	—	—	—	I	+	—
Festuca gigantea	II	—	—	—	—	+	+	+	—
Impatiens noli-tangere	—	I	—	II	—	I	I	+	I
Rumex sanguineus	—	I	—	—	—	+	I	—	I
v. **Alno-Padion** u. **Salicion (»Populetalia«)**									
Padus avium (*Prunus p.*)	—	—	—	—	—	—	—	—	—
Carex brizoides	—	—	—	—	—	—	—	—	—
C. pendula	—	—	—	—	—	—	—	—	—
Equisetum telmateja	—	—	—	—	—	—	I	—	+
Galeopsis speciosa	—	II	—	+	—	I	I	—	—
Ranunculus ficaria	—	—	—	—	—	—	—	—	—
Rubus caesius	—	—	—	+	—	—	—	—	—
v. **Fagetalia** u. **Pino-Quercetalia**									
Sorbus aucuparia	II	I	—	I	—	+	I	—	I
Athyrium filix-f.	II	II	II	II	II	II	I	I	I-
Dryopteris filix-m.	IV	V	IV	IV	IV	II	II	II	III
D. carthusiana	—	I	—	—	—	I	—	—	—
Epilobium montanum	II	III	I	—	III	I	II	I	IV
Hieracium lachenalii	II	I	—	—	—	—	—	+	+
H. maculatum	—	—	—	—	—	—	I	+	I
H. racemosum	—	—	—	—	—	—	I	—	—
Luzula albida	II	—	—	—	I	I	I	I	II
Lysimachia punctata	—	—	—	—	—	—	—	—	—
Majanthemum bifolium	I	—	—	—	I	I	+	—	—
Prenanthes purpurea	IV	I	—	—	II	I	I	—	—
Senecio nemorensis ssp. *fuchsii*	II	IV	I	—	—	—	—	—	—
Viola riviniana	—	—	—	—	—	—	—	—	—
v. **Pino-Quercetalia**									
Betula pendula	II	—	—	—	—	I	I	—	—
Castanea sativa	—	—	—	—	—	—	—	—	—
(*Calluna vulgaris*)	—	—	—	—	—	—	—	—	—
Vaccinium myrtillus	—	—	—	—	—	—	—	—	—
Calamagrostis arundinacea	—	—	+	+	—	+	I	—	I
Cytisus (*Chc.*) *supinus*	—	—	—	—	—	—	—	—	—
Deschampsia flexuosa	—	—	—	—	—	—	+	—	—
Genista pilosa	—	—	—	—	—	—	—	—	—

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
IV	V	III	II	II	V	V	V	!	IV-	IV	IV	V	!
I	II	—	I	II	—	I	—	!	IV	—	+	+	!
+	I	—	I	I	II	I	I	—	II	—	+	—	!
III	I	V	II	IV	—	II	I	!	II	I	—	—	!
+	I	—	I	I	I	I	—	—	II	+	—	—	—
—	—	—	—	—	I	I	I	—	—	—	—	+	—
+	II	I	I-	I	I	—	II	—	II	—	+	I	!
—	—	—	—	—	—	—	—	—	I	—	—	—	—
I	I	II	II	III	II	—	I	!	III	II	+	+	!
IV	III	III	III-	III	I	—	—	!	—	—	—	—	—
I	I	II	I	I	I	I	—	—	I	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	I	—	I	—	I	—	—	+	—
+	—	+	—	—	—	I	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
II	—	—	—	I	II	—	—	!	—	+	—	—	—
—	—	—	—	III	—	I	—	—	—	—	—	—	—
—	—	—	I	I	I	I	—	—	—	—	—	—	—
—	I	I	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	I	—	I	II	—	—	—	—	—	—
—	—	—	I	—	II	III	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	I	—	—	—	—
—	—	—	—	—	—	—	I	—	—	—	—	—	—
—	—	—	—	—	—	—	I	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	I	III	—	—	—	—	—	—	—	—
I	—	II	II	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	+	—	—	—	—	—	—
—	—	—	—	—	I	—	—	—	—	+	—	—	—
I	—	—	I	II	II	I	I	!	III	+	—	+	—
I	—	+	II	II	V	I	I	!	IV	+	—	—	—
—	—	—	—	—	I	—	—	—	I	—	—	—	—
I	—	—	I-	II	IV	II	I	!	I	II	—	+	—
—	—	—	—	I	—	—	—	—	—	+	+	+	!
—	—	—	—	—	—	—	—	—	—	+	—	—	—
—	—	—	—	I	—	—	—	—	—	—	—	—	—
—	—	—	—	I	II	I	II	!	II	V	V	V	!
I	—	—	—	—	I	I	—	—	—	—	—	—	—
—	—	—	—	I	II	—	II	—	—	—	—	I	—
—	—	—	—	—	—	—	II	!	I	—	+	II	!
—	—	—	—	I	—	—	—	I	—	—	+	—	—
—	—	—	—	I	—	II	—	—	II	—	—	—	—
—	—	—	—	—	I	I	I	—	—	II	—	II	!
—	—	—	—	—	—	—	—	—	—	—	I	I	—
—	—	—	—	—	—	—	—	—	—	—	—	I	—
—	—	—	—	—	—	—	—	—	—	(II)	V	III	—
—	—	—	—	—	I	I	—	—	II	I	—	—	!
—	—	—	—	—	—	—	—	—	—	—	(A)	—	—
—	—	—	—	—	—	+	—	—	—	II	V	V	!
—	—	—	—	—	—	—	—	—	—	(II)	—	—	—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Hieracium sabaudum	—	—	—	—	—	—	I	I	—
H. umbellatum	—	—	—	—	—	—	—	—	—
Melampyrum pratense agg.	—	—	—	—	—	+	—	—	—
Huperzia selago	—	—	—	—	—	—	—	—	—
Pteridium aquilinum	—	—	—	—	—	—	—	—	—
Pyrola rotundifolia	I	—	—	—	—	+	+	—	—
Veronica officinalis	II	I	—	—	—	+	I	I	I
(*Viola canina*)	—	—	—	—	—	—	—	—	—
v. **Querco-Fagea**									
Acer campestre	I	—	—	—	II	II	I	I	—
A. platanoide	V	V	I	I	I	I	—	—	—
Cornus sanguinea	—	I	—	—	—	—	—	—	—
Corylus avellana	II	I	—	—	I	I	I	I	II
Crataegus monogyna	I	—	—	—	I	—	I	—	—
C. oxyacantha (*laevigata*)	—	II	—	—	—	I	+	—	—
Euonymus europaea	—	—	—	—	—	—	—	—	—
E. verrucosa	—	—	—	—	—	—	—	—	—
Frangula alnus	—	—	—	—	—	—	—	—	—
Ligustrum vulgare	I	—	—	—	I	—	—	—	—
Lonicera xylosteum	II	II	—	—	—	I	—	—	—
Populus tremula	II	—	—	—	II	+	+	—	—
Quercus petraea	II	—	—	—	V	II	I	—	—
Q. robur	—	—	—	—	—	—	—	—	—
Sorbus torminalis	I	—	—	—	—	—	I	—	—
Staphylea pinnata	—	I	—	—	—	—	—	—	—
Ulmus minor	—	—	—	—	—	—	—	—	—
Viburnum lantana	—	—	—	—	—	—	—	—	—
V. opulus	—	—	—	—	—	—	—	—	—
Ajuga reptans	II	II	II	—	—	III	II	—	—
Arum maculatum agg.	I	—	—	—	—	I	I	I	—
Astragalus glycyphyllos	—	—	—	—	I	I	I	—	—
Brachypodium sylvaticum	—	I	I	+	I	II	I	I	—
Bromus benekenii	II	II	—	—	—	II	—	—	—
Calamintha clinopodium	—	—	—	—	I	I	—	—	—
Campanula rapunculoides	I	I	I	I	I	I	II	—	—
C. persicifolia	I	—	—	—	I	I	I	I	—
(*C. patula*)	—	—	—	—	—	I	—	—	—
Carex divulsa	I	I	—	—	—	—	—	—	—
C. pairae	—	—	—	—	—	I	—	—	—
C. spicata	—	—	—	—	I	+	+	—	—
C. montana (—*Pino-Q.*)	I	—	—	—	—	—	—	—	—
Cephalanthera damasonium	—	—	—	—	—	I	—	—	—
C. longifolia	I	—	—	—	—	II	I	+	—
C. rubra	—	—	—	—	—	I	I	—	—
Clematis vitalba	—	I	—	—	—	+	I	+	—
Convallaria majalis	—	—	—	—	—	I	—	—	—
Cruciata glabra	I	I	—	—	II	II	I	—	—
Dactylis polygama	I	I	I	—+	I	II	I-	I	—
Digitalis grandiflora	II	—	—	—	I	I	+	—	—
Epipactis helleborine	II	III	—	—	—	I	I	+	—
Festuca heterophylla	I	—	—	—	—	I	I	+	—
Fragaria vesca	—	II	III	—	I	II	II	I	II
Galeopsis pubescens	I	—	—	—	—	I	+	—	—
Galium schultesii	IV	II	—	—	—	III	II	+	III
Geranium robertianum	II	V	I	+	—	II	I	I	II
Geum urbanum	III	I	I	+	I	—	II	II	—
Heracleum sphondylium	I	I	I	+	—	II	I	+	—
Hieracium sylvaticum	I	I	I	—	—	I	I	—	—

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
I	—	I	—	—	—	—	I	—	—	+	—	I	!
—	—	—	—	—	—	—	—	—	—	—	+	—	—
—	—	—	—	—	I	—	I	—	—	—	III	III	!
—	—	—	—	—	—	—	—	—	—	I	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	II	—
—	—	—	—	I	—	—	—	—	—	—	—	—	—
—	—	—	—	—	I	—	II	—	—	III	—	II	!
—	—	—	—	—	—	—	—	—	—	+	—	—	—
I	II	III	II-	IV	III	IV	—	—	III	—	—	—	—
I	III	III	III	II	I	I	—	—	I	—	—	—	—
I	II	—	—	II	I	I	—	—	—	—	—	—	!
—	—	—	—	I	III	III	I	—	II	—	II	I	—
+		I	I	III	III	III	—	—	I	—	—	—	—
I	II	—	—	I	I	—	—	—	—	—	—	—	—
—	II	II	II	III	—	I	I	—	I	—	—	I	!
—	III	—	—	I	I	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	I	—	I	—	—	I	!
—	I	—	—	—	—	—	I	—	I	—	—	I	!
—	I	—	I	—	II	I	—	—	—	—	—	—	—
—	—	—	—	—	I	—	I	—	I	—	—	—	—
II	—	—	—	II-	—	—	—	—	—	—	—	I	—
I	—	—	II	IV	I	I	—	—	—	—	—	—	—
—	—	—	—	—	I	I	I	—	—	—	—	—	—
—	I	—	I	I	I-	III	—	—	—	—	—	—	!
—	I	I	I-	I-	—	I	—	—	—	—	—	—	!
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I	III	—	—	II	—	—	—	—	II	—	—	—	—
I	—	+	I	I	I	III	I	—	II	—	II	I	!
—	—	—	—	—	—	—	I	—	I	—	—	+	—
—	I	—	—	I	I	—	I	—	—	—	—	—	—
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—	—	—	I	I	I	—	—	—	I	—	—	—	!
—	I	+	—	—	I	—	—	—	—	—	—	—	—
—	II	I	II	I	I	I	—	—	—	+	—	—	—
—	IV	—	—	I	I	I	I	—	I	—	—	—	!
—	—	—	—	—	—	—	—	—	I	—	I	I	—
II	I	III	II	I-	II	III	III	!	I	—	+	+	!
—	—	—	—	—	I	—	—	—	—	I	—	—	—
—	I	—	I	I	I	I	—	—	—	—	—	—	—
—	—	—	—	I	II	I	I	—	—	—	—	I	—
II	—	+	I	II	V	I	I	—	III	II	—	—	!
—	+	—	I	III	—	—	+	—	—	—	+	—	—
II	II	—	—	—	—	—	—	—	—	II	—	—	—
IV	II	IV	III-	I	IV	IV	I	—	II	—	—	—	—
II	IV	II	I	II	III	III	II	—	II	+	+	—	—
—	—	—	I	I	II	I	I	—	—	—	—	—	—
I	I	—	—	I	I	I	II	!	II	(I)	III	I	!

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Hypericum hirsutum	I	II	—	—	—	I	I	I	—
H. montanum	I	—	I	+	II	I	I	I	—
Lactuca quercina	—	I	—	+	—	I	I	—	—
Lapsana communis	—	II	—	—	I	II	I	—	—
Lathyrus niger	—	—	—	—	—	I	I	—	—
Melica nutans	III	—	—	—	I	—	—	+	—
M. uniflora	—	I	—	—	—	V	I	+	—
Melittis carpatica em.	—	—	—	—	I	I	I	+	—
Moehringia trinervia	V	I	I	+	I	—	I	—	—
Mycelis muralis	V	V	—	—	V	II-	I	+	I
Neottia nidus-avis	III-	I	—	—	I	I	I	I	—
Platanthera bifolia	II	I	—	—	—	I	I	+	—
Poa nemoralis	IV	III	II	II	IV	II	IV	—	III
Polygonatum latifolium	—	—	—	—	—	+	—	—	—
P. multiflorum	II	II	—	—	—	II-	II	—	—
Primula veris	I	—	—	—	—	+	—	—	—
Ranunculus auricomus	II	I	—	—	I	+	I	I	—
agg. (»*cassubicus*«)	I	—	—	—	—	II	—	—	—
Scrophularia nodosa	I	III	I	+	I	I	II	III	—
Symphytum tuberosum ssp. *nodosum*	II	I	I	I	I	II	I	—	—
(*Sedum maximum*)	—	—	—	—	—	+	—	—	—
Tanacetum corymbosum	—	I	I	+	—	II	I	I	—
Trifolium medium	—	—	—	—	—	+	+	I	—
Veronica chamaedrys	II	I	—	—	II	II	II	—	—
Vicia dumetorum	—	—	—	—	—	+	I	I	—
V. sepium	—	—	—	—	—	—	I	—	—
Viola alba	—	—	—	—	—	—	—	—	—
V. cyanea	—	II	—	—	—	+	—	—	—
V. mirabilis	—	I	—	—	—	I	—	—	—
V. odorata	—	—	—	—	—	I	—	—	—
V. silvestris	V	V	—	—	—	V	IV	IV	I
v. **Quercetea pubesc.- petraeae**									
Cornus mas	—	—	—	—	—	I	—	—	—
Prunus spinosa	—	—	—	—	I	—	—	—	—
Quercus cerris	—	—	—	—	—	—	—	—	—
Rosa canina agg.	I	I	—	—	I	I	—	—	I
R. dumalis (vosagiaca)	—	—	—	—	—	—	—	—	—
Sorbus aria agg.	—	—	—	—	—	—	—	—	—
Arabis turrita	—	I	—	—	—	—	—	—	—
Betonica officinalis	—	—	—	—	—	I	—	—	—
Calamintha officinalis	—	—	—	—	—	—	I	—	—
Cytisus (Chc.) hirsutus	—	—	—	—	—	—	—	—	—
Fragaria viridis	—	—	—	—	I	—	—	—	—
Genista tinctoria ssp. *elatior*	I	—	—	—	—	+	—	—	—
Laser trilobum	—	—	—	—	—	I	—	—	—
Lembotropis nigricans	—	—	—	—	—	—	I	—	—
Lithospermum purp.-coer.	—	—	—	—	—	—	—	—	—
Polygonatum odoratum	—	—	—	—	—	—	—	—	—
Pulmonaria mollissima	—	—	—	+	—	—	—	—	—
Ranunculus polyanthemos	—	—	—	—	—	—	—	—	—
Silene nutans	—	—	—	—	—	+	+	—	—
S. viridiflora	—	—	—	—	—	+	—	—	—
S. vulgaris	—	—	—	—	—	—	—	—	—
Solidago virgaurea	—	—	—	—	—	—	—	—	—
Valeriana stolonifera (»*collina*«)	—	—	—	—	—	+	—	—	—
Verbascum austriacum	—	—	—	—	—	—	—	—	—
Vicia pisiformis	I	—	—	—	—	—	—	—	—

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
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—	—	—	—	—	—	—	—	—	—	—	—	—	—
II	V	II	III	III	I	III	II	—	—	—	I	II	—
—	I	+	—	I	—	I	I	—	I	—	—	—	!
II	I	II	I	I	—	—	I	!	I	II	III	—	—
III	II	IV	IV	III	IV	IV	III	!	III	I	—	I	—
—	I	—	—	I	I	I	I	!	—	+	—	—	!
—	—	+	—	II	I	I	I	—	—	II	—	+	—
II	—	II	I	I	IV	III	I-	—	I	I	—	I	!
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I	—	II	—	I-	II	II	I	—	II	II-	—	—	—
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—	III	+	—	I	I	I	—	!	—	—	—	—	—
—	III	+	I	—	I	III	—	—	—	—	—	—	—
—	III	IV	V	IV	IV	II	III	!	V	II	—	—	—
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—	—	—	—	—	—	—	—	—	—	—	—	—	—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Viola hirta	—	—	—	—	—	—	—	—	—
Vincetoxicum hirundinaria	—	—	—	—	—	—	—	—	—
v. **Abieti-Piceea** resp. **Vaccinio-Piceetea**									
Picea abies	—	—	—	—	—	—	—	—	—
Pinus silvestris	—	—	—	—	—	—	—	—	—
Monotropa hypopithys agg.	—	—	—	—	—	—	+	—	—
Moneses uniflora	—	I	—	—	—	—	—	—	—
Orthilia secunda	II	—	—	—	—	II	—	—	—
Pyrola minor	—	—	—	—	—	—	—	—	—
v. **Sambucetalia**									
Salix caprea	II	—	—	—	I	—	I	—	I
Sambucus nigra	—	II	—	—	—	+	—	—	—
S. racemosa	—	—	I	I	—	+	I	I	—
v. **Epilobietalia**									
Atropa bella-donna	—	I	—	—	I	+	+	—	—
Epilobium angustifolium	II	I	—	—	—	—	—	—	—
Gnaphalium sylvaticum	I	—	—	—	—	—	—	—	—
v. **Alliarion**									
Alliaria petiolata	II	I	II	II	—	I	I	—	—
Cardamine flexuosa	—	—	—	—	—	—	—	—	—
Chaerophyllum temulum	—	II	—	—	—	II	I	+	—
Chelidonium majus	—	I	—	—	I	—	II	+	—
Geranium lucidum	—	—	—	—	—	—	—	—	—
Parietaria erecta	—	—	—	—	—	—	—	—	—
Polygonum: Fallopia dumetorum	—	II	—	—	—	I	—	—	—
Smyrnium perfoliatum	—	—	—	—	—	—	—	—	—
Torilis japonica	—	—	—	—	I	+	—	—	—
v. **Asplenietea**									
Asplenium trichomanes agg.	—	I	—	—	—	+	+	—	—
Polypodium vulgare	—	—	—	—	—	—	—	—	II
Gesellschaftsvage o. **fremde** Arten (z. B. **Molinio-Arrhenatherea**)									
Ajuga genevensis	—	—	—	—	—	—	I	I	—
Anthriscus sylvestris	—	I	—	—	—	I	I	—	—
Calamagrostis epigeios	—	—	—	—	—	I	—	—	—
Campanula rotundifolia	—	—	—	—	—	—	—	—	—
Eupatorium cannabinum	—	I	—	—	—	—	—	—	—
Galium aparine	—	I	—	—	—	III	+	—	—
Hypericum perforatum	—	—	—	—	—	—	—	+	—
Leontodon autumnalis	—	—	—	—	—	—	—	—	—
L. hispidus	—	—	—	—	—	—	—	—	—
Prunella vulgaris	—	—	—	—	I	+—	+	—	—
Ranunculus acris	—	—	I	+	—	—	I	—	—
R. repens	—	I	—	—	—	I	—	—	—
Senecio barbareifolius	—	—	—	—	—	—	—	—	—
Solanum dulcamara	—	I	—	—	—	—	—	—	—
Stellaria media	—	—	—	—	—	—	—	—	—
Taraxacum officinale agg.	—	I	—	—	—	—	—	—	—
Veronica serpyllipolia	—	—	—	—	—	I	—	—	—
Urtica dioica	I	I	—	—	—	II	I	+	I

* = nur gepflanzt (A) = in Niederösterreich!

10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
–	–	+	–	I	I	I	I	–	–	–	–	–	–
–	–	–	–	–	I	I	–	–	–	–	–	–	–
–	–	–	–	–	–	–	I*	–	II*	–	V*	–	–
–	–	–	–	–	–	–	I*	–	II	–	IV*	I	–
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I	–	–	II	–	I	–	–	–	–	–	–	I	–
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–	–	–	III	I	I	I	–	–	–	–	–	–	–
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–	I	+	–	I	I	II	–	–	–	–	–	–	–
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I	I	–	–	–	–	–	I	–	–	–	–	–	–
II	I	+	+	I	I	I	–	–	–	–	–	–	–
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II	I	+	I	III	–	–	I	–	–	–	–	–	–
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I	I	–	–	III	II	I	+	–	–	–	–	–	–
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II	–	–	II	II	II	II	I	–	I	–	–	+	–

LITERATUR

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CORRELATION BETWEEN GYNOECIUM AND ANDROECIUM IN PRUNOIDEAE SPECIES*

By

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On the basis of 100 flowers of five species each of the most important grown species of the *Prunoideae* subfamily (apricot, peach, plum, and gage, cherry, sweet and sour cherry) a negative correlation could be pointed out between gynoecium and androecium. The correlation could be confirmed already from all the 2500 flower data, and even the average pistil length and number of stamina values of 100 flowers each of the species not included in the calculations (*Amygdalus communis*, ×*Amygdalopersica hybrida*, *Armeniaca mume*, *Prunus cerasifera*, *Cerasus mahaleb*, *Laurocerasus vulgaris*, and *Padus avium*) line well with the regression curve, that is the above negative trend line can be extended over the whole subfamily.

The frequency in pistil length and number of stamina of each of the species has also been examined separately. The data follow the normal distribution, with one exception, viz. the number of stamina of sweet cherry. Each of the species collectively also show a normal dispersion. This fact enhances the reliability of the statistically proved correlation between gynoecium and androecium.

Introduction

The research into the correlation between pistil and stamina is important from the viewpoint of both evolutionary and fertility biologies. Correlation between pistil and stamina have been demonstrated in a great number of species so far. Especially in the case of *Hyosciamus niger*, *Bryophyllum daigremontianum* and *Silene pendula* species the results are remarkable (RUHLAND 1967).

In one of our earlier examinations we proved that there is negative correlation between pistil and number of stamina (SURÁNYI 1973). It is important to put emphasis on this because constitutional sterility could be in terpreted on the basis of regression, while the quotient differences confirmed the fact that the number of stamina falling to one unit of pistil size is an indicator related to self-fertility.

RESENDE's Chapter in Vol. XVIII of *Handbuch der Pflanzenphysiologie* provided an important basis for our work, by helping on the one hand in explaining the explored phenomena (The differences in the vegetative character

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of flower organs, the role of additive genes in sexuality), and on the other hand it also became possible for us to consider the influencing role of environmental factors (geographical latitude, soil humidity, climatic conditions) (GARDNER, BRADFORD, HOOKER 1952, SCHWANITZ 1967).

Material and method

Our examinations carried out in 1971 hardly differ from a methodical point of view from the sampling form described previously. We collected 500 pieces of flowers from each of the species, i.e. 100 pieces from each variety. The following species, and varieties emerged in the examination: *Armeniaca vulgaris* (Scarlet of Cegléd typ. C. 244, Giant apricot typ. C. 255, Hungarian apricot typ. C. 256, Paviot and Luizet), *Persica vulgaris* (Elberta, Shipley, Champion, Mayflower and Alexander), *Prunus domestica* and *P. insititia* (Hungarian plum, Italian Pruna, Royal Green Gage, Prinze Red Gage, Jerusalem blue), *Cerasus avium* (Küpper's Frühkirsche, Bing, Germersdorfer grosse Kirsche, Hedelfingener Riesenkirsche, and Mückeberger Kirsche), *Cerasus vulgaris* (Ostheimer Weichsel, de Montreuil sour cherry, Pándy's Glas-Weichsel, Gypsy sour cherry and Grand English).

In the course of statistical evaluation, the closeness of correlation was calculated in the case of each species, then the r-value was determined from all the 2500 data collectively. The practical dispersion of flowers related to the intervals of the determined pistil length and number of stamina was also examined, i.e. whether the various species disperse identically, and whether these dispersions can be adjusted to the curve of normal dispersion. The flowers could be classified into 6—6 intervals in the case of each species. All the intervals are included in Fig. 7, i.e. the critical Chi^2 value had to be calculated according to the FG = 3 degree of variation.

The pistil lengths and number of stamina of flowers in *Prunus* species not used in our calculations of correlation were also determined on the basis of 100 flowers from each. Of them along the regression curve in Fig. 6 was indicated this by not underlining the name of species such as *Padus avium*, *Cerasus mahaleb*, *Prunus cerasifera*, *Armeniaca mume*, *Amygdalus communis*, $\times$*Amygdalopersica hybrida* and *Laurocerasus vulgaris*.

With the use of average pistil length and number of stamina deriving from 500 respectively 100 pieces of flowers from the species each the quotient was calculated, i.e. the number of stamina related to pistil length per unit. No variance analysis was performed, since the increase in quotient values and rising of the negative trend line were in good harmony and since we had obtained significant results between the grown *Prunus* species.

Results and discussion

From the flower data of the five apricot varieties appearing in the culture, a fairly certain inverse correlation between pistil length and number of stamina could be pointed out. A pistil length of 14—17 mm, which may be characteristic of the species, is dominant, although considerably deviating certain varieties are from this and have effect enviromental factors, too. The number of the stamina mostly fluctuates between 30—32, but in irregular flowers a considerably smaller number of stamina may also occur. This is even more relevant to other species of the *Armeniaca* genus, for example, pistils of 11—14 mm occur, while the number of stamina is 34—36 such as the *Armeniaca mume* and *A. ansu*.

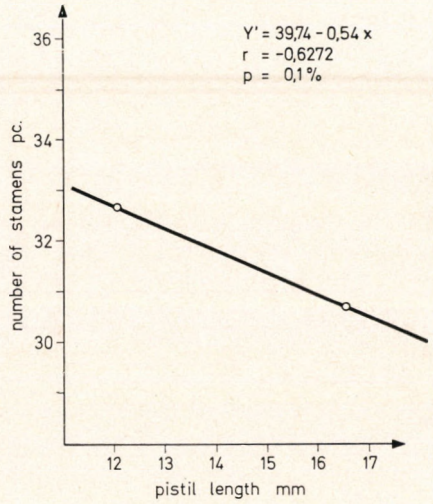

Fig. 1. Connection between pistil length and stamen number in apricot (*Armeniaca vulgaris*

The peach varieties Champion, Shipley, Elberta, Alexander and My flower collectively give looser correlation. The trend of the curve is similar to that of the apricot, with the difference that the number of stamina is higher and in general also longer. This smaller error was equitted in the course of collective examination of the species, which is demonstrated well by the point indicating peach.

Certain varieties of the *Prunus domestica* and *Prunus insititia* species have been included in Fig. 3 from practical consideration. As a consequence of this, it happened that the steepness of the line became fairly high, while the plum varieties and the gages separately meant a *b*-value between 0.4 and 0.7 each. Regarding this, no detail is given in the present study.

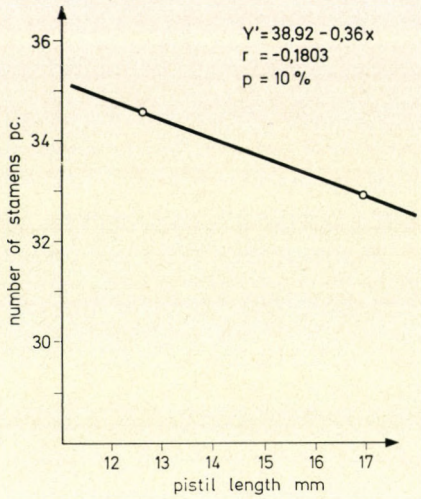

Fig. 2 Connection between pistil length and stamen number in peach (*Persica vulgaris*)

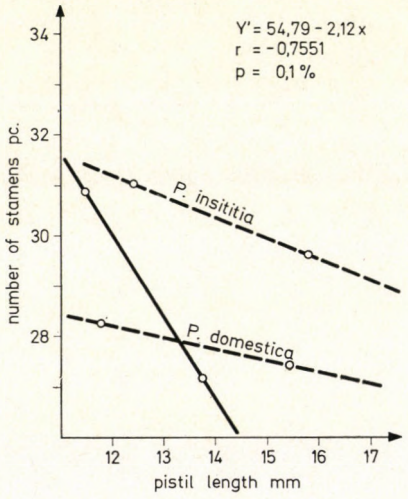

Fig. 3 Connection between pistil length and stamen number in plum and gage (*Prunus domestica* and *Prunus insititia*)

In the flowers of the sweet cherry varieties the most frequent is a pistil length of 13—14 mm, which generally 36—38 stamina belong. If however the stamina (or only the anther) become leafy, even a more longer pistil may develop. MÜCKEBERGER sweet cherry proves this unequivocally. In connection with a frequent leafing of the anther in such irregular flowers pistils of about 17 mm length appear.

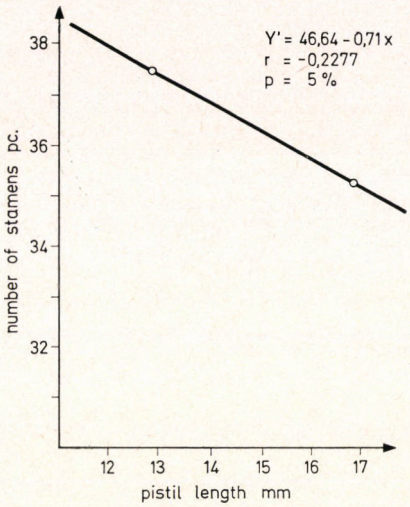

Fig. 4 Connection between pistil length and stamen number in sweet cherry (*Cerasus avium*)

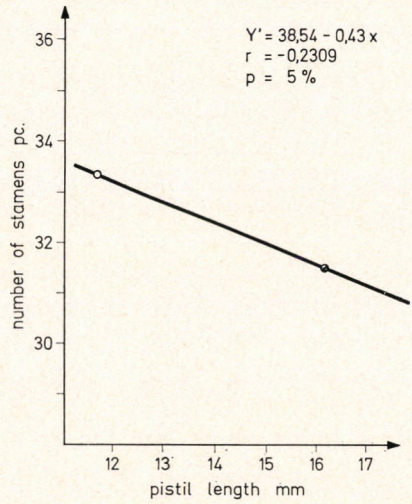

Fig. 5 Connection between pistil length and stamen number in sour cherry (*Cerasus vulgaris*)

In comparison with sweet cherry, sour cherry varieties produce less stamina and longer pistils. Irregularity may occur very rarely in the flowers, but this cannot be considered a frequent phenomenon in the case of sweet and sour cherry. In the flowers of sour cherry pistils of 15 mm length are predominant, and mainly 33—35 stamina are frequent.

The fluctuations in pistil length and number of stamina in the *Prunus* species examined are not independent of each other but are closely related

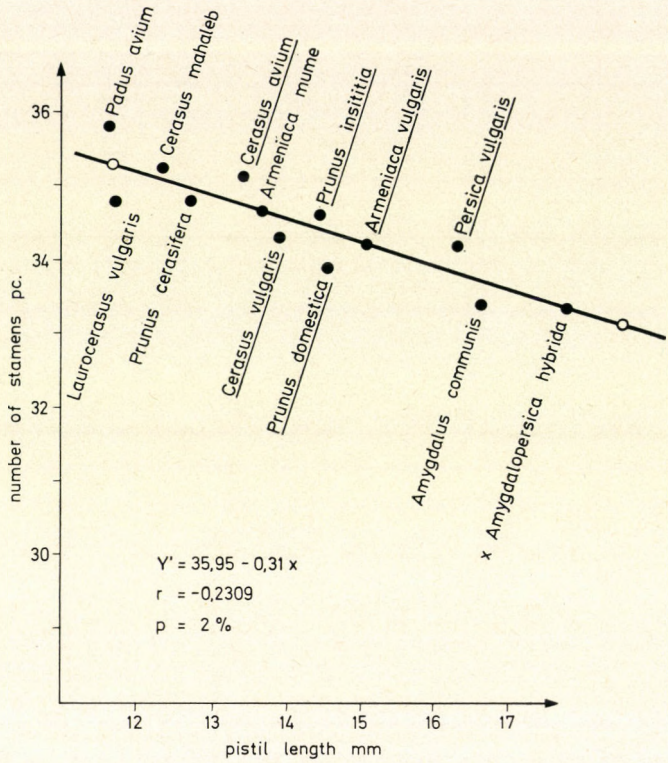

Fig. 6 Connection between pistil length and stamen number in all *Prunus*
Note: Regression curve was counted from the underlined species

correlative phenomena, which is demonstrated in Fig. 6 well. This is so much true that even those species appear along the trend line characteristic of *Prunus* which were not incidentally used for the calculation of the trend line. Fairly slight fluctuations manifested themselves in the coordination points determined with the use of average pistil lengths and number of stamina in the case of *Padus avium*, *Cerasus mahaleb*, *Prunus cerasifera*, *Armeniaca mume*, *Amygdalus communis*, *Laurocerasus vulgaris* and $\times$*Amygdalopersica hybrida*.

By examining also the character of dispersion in pistil lengths and number of stamina of the various species, we wanted to enhance the reliability of our statistical calculations. Because of the reasons mentioned in the Material and Method part of our study, we compared the frequency in pistil lengths and number of stamina values with the most frequent dispersion form. All followed the normal dispersion, with the exception of one, viz. the number of stamina in sweet cherry. As regards the exception it may be mentioned that it is probably the consequence of only a sampling error, and it just surpasses the critical Chi^2-value.

Table 1

Prunus species: Control of normal dispersion of pistil length and stamen number with Chi²-test

Species	Pistil length	Number of stamens
Armeniaca vulgaris	6.22	2.37
Persica vulgaris	3.42	4.99
Prunus domestica, Prunus insititia	5.25	7.83
Cerasus avium	2.17	8.80+
Cerasus vulgaris	1.41	3.45
Chi²-value (p = 5%)	8.71	

In view of the fact that the correlation calculation results are being similar by species and collectively, and of the fact that pistil lengths and number of stamina of the some species followed a normal dispersion character, we demonstrated also the dispersion form of all the 2500 pieces of *Prunus* flower. According to Fig. 7 the character of normal dispersion is predominant both longitudinally and cross-sectionally.

A correlation can be observed between the quotient of the 13 species in Fig. 6 and the negative trend line, namely, along the lowest points of the

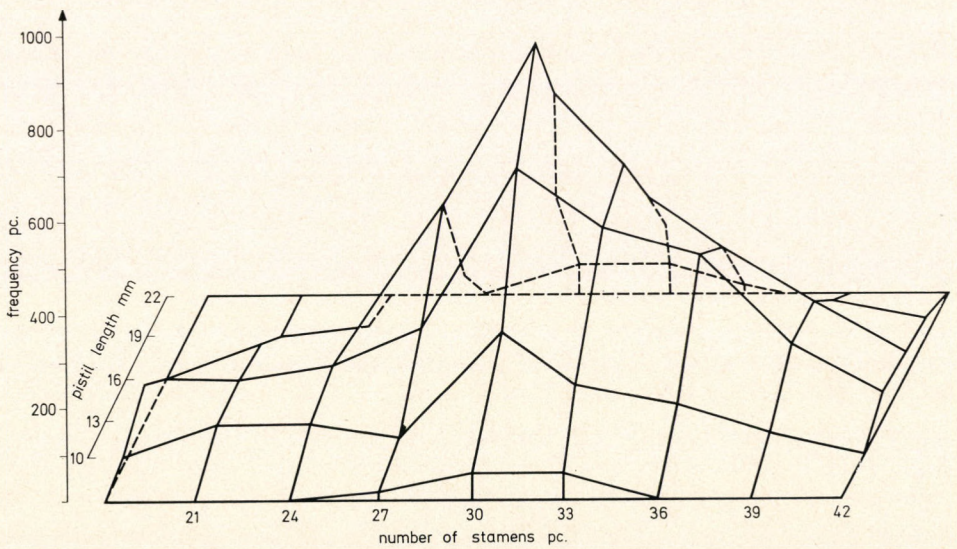

Fig. 7 Dispersion curve of pistil length and the stamen number in all *Prunus* together (n = 2500)

line almond and *Amygdalopersica* are situated. The pistil is above 20 mm, while even from the few stamina may be individuals that have become leafing that is lost function.

The quotient of a few species coming next is still relatively low, the pistil is most frequently possible up to 20 mm, while the number of stamina is about 30. According to our earlier examinations, the apricot, peach, and plum are of a significantly lower quotient than the next *Cerasus*, *Padus*, *Laurocerasus* genus. In between there are some species which are transitional from the point of view of self-fertility, viz. the *Prunus institutia*, *Armeniaca mume*, and the *Cerasus vulgaris*. Among them, there are self-fertile, semi-self-fertile and self-sterile species as well.

Table 2

Quotient of stamen number per pistil length in Prunus species (See also Figure 6)

Species	Quotient, pc./mm
Amygdalus communis	1.54
×*Amygdalopersica hybrida*	1.77
Prunus domestica	1.90
Persica vulgaris	1.93
Armeniaca vulgaris	2.15
Prunus insititia	2.28
Armeniaca mume	2.40
Cerasus vulgaris	2.42
Cerasus avium	2.56
Prunus cerasifera	3.25
Cerasus mahaleb	3.32
Laurocerasus vulgaris	3.47
Padus avium	5.26

Table 2 practically shows that the *Prunoideae* represents a self-fertility inclination only in the case of such correlation between pistil length and number of stamina that can be considered optimal, i.e. determined interval of the quotient represents the self-fertile species and this is so also within the species. The best example is offered by the very transitional species. The sour cherry de Montreuil is self-fertile; according to its quotient it may be put more ahead in the line than the place where sour cherry as species can be found. Or, demonstrating by another example, the various varieties of the *Prunus domestica* may also be self-fertile. For example, the Jerusalem blue has a higher quotient (2.31) than the one characteristic of plum. In other words, the to long pistil is not advantageous (almond, *Amygdalopersica*), because the

pistil area inhibits the possibility of self-fertility by obstructing inhibiting androecium. Supposedly, this is impossible in the flowers possessing many stamina, or it is possible only to a fairly small extent, because the androecium suppresses the gynoecium, so the pistils are of small size. This debilitation, or strengthening (of the androecium), refers to individual flowers, but in the last analysis the too low or too high quotients necessitate the pollination by alien.

It is interesting to see the situation on the basis of fluctuations in the size of flowers, and their situation in the tree. Almond and *Amygdalopersica* are large flower, the flowers mostly occur singly. The flowers of the self-fertile species are smaller, they can be found often in small groups on the brindille. The transitional species, especially the entirely self-fertile ones, have considerably smaller flowers, and they mostly form fluorescence. In these species pollen is produced in such a quantity that the possibility of wind pollination is also given, as it is indeed supposed by some researchers recently. Teratological events are known mainly in the flowers of the older species of *Prunonoideae* which can be considered a micro-evolutionary row of species. Namely, several pistils in one flower (Kirke's plum), twin-pistility (apricot, almond, peach), partial or complete transformation of the stamina into petal, or petal-like formula (mainly the plum varieties, but also almond and certain peaches as well, while in the *Cerasus*, *Laurocerasus* and *Padus* genus, which can be considered more developed, teratological events more infrequent.

The present study is a completion of the flower morphological examinations into *Prunus* species, which will serve as a basis for the experiments to explain the hormonal causes of the results which have been published. For it is the antagonism between gynoecium and that androecium which suggests the problem of apical dominance as regards the development of shoot system and the formation of shoots with retarded growth and modified shoots (flowers). For the gynoecium as a formula of determining character (dominant) is feeble, the side formules — stamina — are liberated from the inhibition, i.e. more stamina develop (for example, in sweet cherry); but a reversed situation is also possible, when the gynoecium as it were inhibits the androecium, bringing into existence teratomata, or the numerical decrease of stamina (For example, in almond).

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Professor Dr. SÁNDOR SÁRKÁNY and Professor Dr. GYÖRGY MÁNDY for all the trouble they have taken in making critical comments on the manuscripts, for valuable remarks, as well as to Dr. BÉLA I. POZSÁR chief of scientific department for his useful advice in my work which has been carried on since 1968, and for his help in the interpretation of the results.

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DORMANCY IN FRUITS OF TILIA PLATYPHYLLOS SCOP. II THE INHIBITOR—SUBSTANCE CONTENT OF DORMENT FRUITS

By

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The nature of the state of dormancy in *Tilia platyphyllos* seeds has been examined from various aspects. Our results are summed up below.

(1) There are inhibitors both in the pericarp and the seed, the amount of which decreases during stratification.

(2) It appears that the inhibitors of the pericarp operate as antibiotics and antifungals, defending the seed against the pathogenous soil microbes during the long period of germination.

(3) The semen (endosperm and embryo) contains ABA, whose effect to maintain dormancy is strengthened by the high concentration of IES.

(4) The destructive decay of the inhibitors during stratification happens sooner in the pericarp than in the embryo and the endospermium.

(5) On the other hand, in the interruption of dormancy a triggering part may be played by a substance not known more closely, which appears at a 0.45—0.6 Rf value in are isopropanol: ammonia: water solvent, and whose quantity increase very rapidly in the 4—5th month of stratification. Concerning its nature it is presumably some gibberellin-like compound.

Introduction

The study of the state of dormancy in seeds is significant mainly for agri- and silviculture, in sofar as timber tree saplings are grown from seed in forest nurseries. The seeds of our most important forest and industrial trees germinate with much difficulty; bad germination vigour and low percentage of germination are characteristic of them, which means an economically expensive and labour-consuming gathering of huge quantities of seed if the required increase in stock is to be guaranteed in the nurseries.

Information on the general causes of dormancy (e. g., the undeveloped state of the embryo, the presence of the pericarp impermeable by water, or of various inhibitors, etc.) is not sufficient for economically improving the germination of *Tilia* seeds. A complete exploration of the physiological background is also necessary.

The fruit of *Tilia platyphyllos* is surrounded by an extremely thick pericarp nearly impermeable to water. This pericarp originally envelops 5 to 2 ovules, but only one develops into a normal embryo. Since the seed falls down, together with the aborted ovules in the enclosing pericarp. This fact cannot be left out of consideration when related to the long dormancy and germination.

Method

In the course of investigation the pericarp was removed and the seed was tested for its inhibitor contents with methods generally known from literature (MITCHELL and LIVINGSTON 1968). It could be established that the pericarp contained a considerable quantity of inhibitor substances (NAGY and SZALAI 1973), which protects not so much the dormancy of the seed as the wet fruits from the pathogenous bacteria and fungi living in the soil.

The factors maintaining dormancy had to be found in the ripe seeds. The pericarp is also extremely hard. During our preliminary experiments we found that its tightly closing cells let the water pass through very slowly, hence the presence of water, one of the important conditions of embryonel growth, was not ensured. We thinned the pericarp by treating it with concentrated sulphuric acid until it became water-soluble in 20—24 hours (MÁRIA NAGY and SZALAI 1973).

However, germination did not ensue even in seeds treated in this way. We inferred therefore that the agents maintaining dormancy were present either in the endosperm or in the embryo, or perhaps in both water, methanol and ether were used as extracting agents (AVERY, CREIGHTON and GEHLAUHA 1940).

Our hypothesis rested on the generally accepted statement that the dormancy of *Tilia* seed is regulated — similarly to various other seeds — by the quantitative relationship between the promotor — inhibitor agents (AMEN 1968, KELLY 1969 and BLACK 1970). While the predomination of the inhibiting effect exists, it remains in dormancy. The cessation of dormancy, the change in hormonal equilibrium, is always caused by the effect of some external factor, which in the case of linden seeds is low temperature.

Experimental results

On the basis of our hypothesis, the first task was to detect the presence of inhibitors, their quantity and the changes in their quantity in the various parts of the seed, namely, in the pericarp, endosperm and embryo. *Sinapis* seed germination test was used to measure the inhibiting effect (Fig. 1).

From the Figure we could unequivocally infer in the case of all three extracts that during storage the extent of inhibition occurring in dormancy decreases. This tendency arises much more pregnantly in the pericarp than in

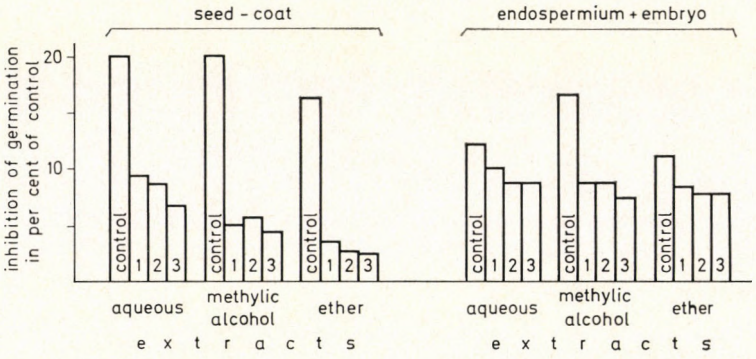

Fig. 1 Germination-inhibiting effect of the pericarp endosperm and embryo of *Tilia*, extracted in water, methanol and ether, on the germination of *Sinapis alba* seeds in various periods of stratification: (1) at 25 °C, (2) at 25 °C stratified in moist state, and (3) at 5 °C stratified in moist state

the endospermium or the embryo. This circumstance allows the inference that in the maintenance of seed dormancy the inhibitor content of the endosperm and of the embryo is more considerable, since under the conditions mentioned its quantity changed to a lesser extent during storage.

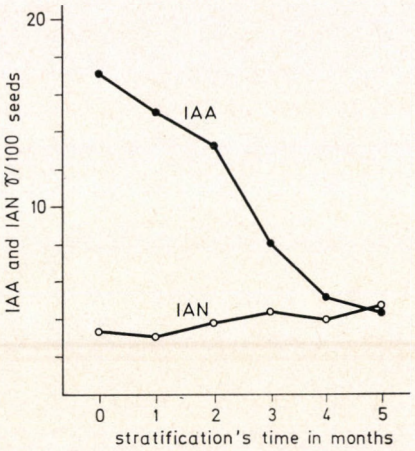

Fig. 2 Changes in the IES and IAN contents of *Tilia* seeds at the time of stratification

During further examinations the growth regulating agents, present in the crude extraction of the endosperm and the embryo together, were broken down to fractions, and the effect of these fractions was measured with *Avena* coleoptile direct growth test (LINSER, MAYR, MASCHED 1954).

Two inhibiting zones appeared uniformly and consistently in our chromatographs run in a solvent of isopropanol: ammonia: water (10 : 1 : 1); namely, at 0.3—0.4 Rf values a component appeared in the neutral fraction showing a declining tendency during stratification, and in the acidic fraction, another component appeared at 0.6—0.8 Rf values with also decreasing quantity. This inhibitor emerged at the position characteristic of abscisic acid (ABA) (KOLLMANN 1970). It is in general characteristic of many seeds in the state of dormancy that the inhibitor content decreases during stratification. Decreasing in inhibitor content was found by LIPE and CRANE (1966) in peach seeds; by MARTIN et al. (1969) in nut; by RUDNICKI (1969) in apple seeds; by WILLEMSEN and RICE (1972) in ragweed seeds. — SONDHEIMER, TZOU and GALSON (1968) also observed the decrease of ABA content during stratification in ash seeds and NIKOLAEVA (1963) and POLYAKOVA (1968) in the seeds of *Malus silvestris*, *Pyrus communis* and *Prunus divarieata*.

Fractionizing and identifying procedures (FLETCHER, ZALIK 1963), however, also showed the presence of IES in a fairly large quantity, which is shown in Fig. 2 in related to 100 seeds.

Tapether IES, also IAN was present in small quantities; however while the quantity of the former decreased permanently and considerably in seeds stored in moist conditions and at low temperatures, the quantity of IAN did not change or did so only within the error limits NIKOLAEVA (1963), DALEZKAJA (1963) and POLYAKOVA (1968) also detected a large quantity of IES in *Acer*

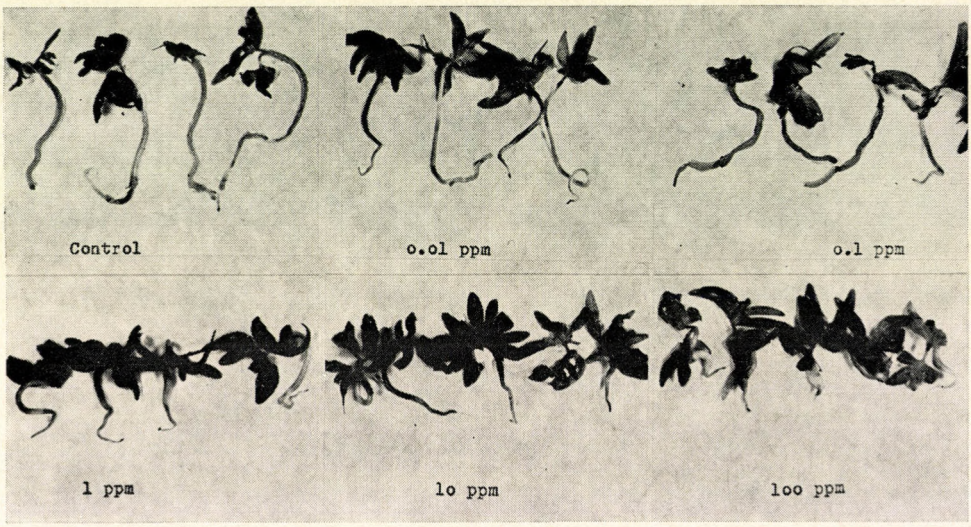

Fig. 3 Effect of exogenous IES on the excised *Tilia* embryos, on the 14th day of the experiment

tataricum seeds and stated that cold stratification causes a decrease in IES content. Since at a high temperature the IES quantity of seeds stored either in dry or in moist state did not change significantly, we arrived at the conclusion that, besides the inhibitors mentioned above, the IES concentration being above the optimum may also play a part of an inhibiting factor. To support this statement we infiltrated seeds in vacuum with IES-oxidase preparation, and thus we managed to reduce the IES level to that found at the end of stratification. The radicule broke through the pericarp in 3—4% of the seeds. The fact that germination did not ensue in a higher percentage allows the inference that in addition to IES other factors also play a part in the maintenance of the state of dormancy.

We verified the inhibitory effect of IES depending on concentration with embryos excised from seeds in the state of dormancy. The embryos were treated in *Petri* dishes under semisterile conditions with varying IES concentrations. On the 14th day the result shown in Fig. 3 was obtained. The increasing IES concentration related to the control showed a proportionate decrease in the growth length.

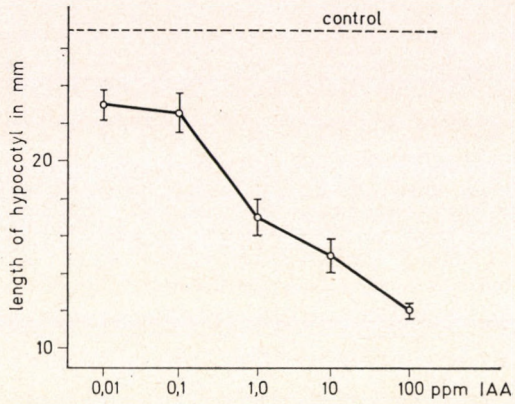

Fig. 4 Effect of the exogeneous IES concentration on the elongation of the hipocotyle in *Tilia* embryos

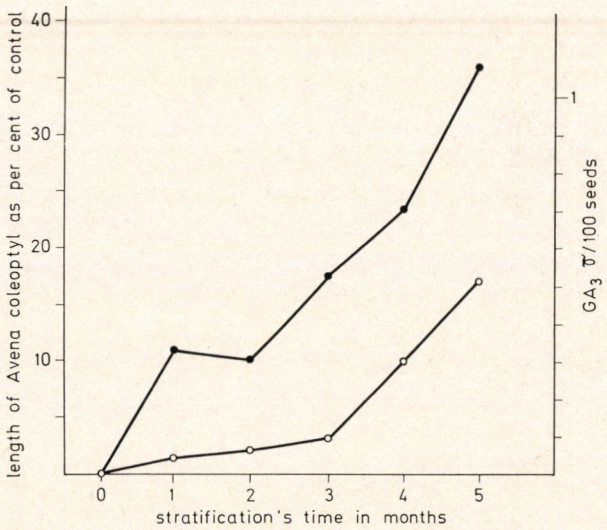

Fig. 5 Effect of the unidentified growth-inhibitory substance of *Tilia* seeds (Rf 0.45—0.6); (above) in the *Avena* coleoptile direct growth test; (below) changes in the endogeneous gibberellin contents of the seeds during stratification

The growth-inhibitory effect of IES appears significantly in the growth length of the hypocotyls (Fig. 4).

In our chromatographs, run in isopropanol: ammonia : water (10 : 1 : 1) solvent, we found also at Rf 0.45—0.6 a spot in each case, which promoted the elongation of *Avena* coleoptile, which increased very rapidly during stratification, but which failed to give the characteristic indol reactions with indol-reagents. There are cases in literature where indol compounds could not be detected with chemical reactions because some other compound present dis-

guised them. Although the possibility of this phenomenon existed in our case, we thought it more likely that we have to deal with a promotor not only of an indol nature. The quantitative increase in the unindentified substance is shown in Fig. 5, where the elongating effect of the *Avena* coleoptile is expressed in the percentage of the control.

Since in the stratified seeds the change in the endogeneous gibberellin content showed an increasing tendency (Fig. 5), we supposed that the stimulator emerging at Rf 0.45—0.6 mentioned above would have to be some gibberellin-like substance even if gibberellin exercises hardly any effect on the elongation of the *Avena* coleoptile. To decide wether it is so, investigations are in process; and with their help the gibberellin nature of the unknown spot may be verified. If the eluatum stimulates, with specific gibberellin tests, any sufficient growth, there can be no doubt left. At present our basis is only a hypothesis which is supported merely by the similar increase in the endogeneous gibberellin content.

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RECENSIONES

HORVÁT A. O.: Die Vegetation des Mecsekgebirges und seiner Umgebung. Akadémiai Kiadó, Budapest 1972. 376 pp + 35 photographs, 8 plates in colour, 111 figures, 56 tables, 1 vegetation map in colour.

This new monograph of plant geography contains the author's work conducted for four decades in the field and the 43 original publications that have come into existance since the floral work (Vegetation of the Mecsek Mountain and of its Southern Plain) was published in 1942. The valuable oeuvre comprises the floristic-coenological plant geography of the Mecsek mountain and of the area south to the Villány mountain, east to the Szekszárd loess region, and North-West to the Zselic hill region. The numerous endemic plants and phanerogamous 138 species are characteristic of the richness of the region. The 12 forest and 8 meadow and grassland associations dealt with in the book, accompanied by a varied ecologic and comparative-vegetation analysis, give a detailed picture of the variegated vegetation. Frequent quotations from southern Slav authors (for example I. HORVAT, M. WRABER, P. FUKAREK, etc.) enrich our home literature considerably.

The general part of the work (pp 1–61) deals with the geography, the petrographic conditions of the region (after F. VADÁSZ), with its climate (by using the WALTER-type diagrams), and with its general geobotanical characterization. In the framework of the latter, this work connects the region as the floral district Mecsekense (or Sopianicum) dissimilarly as the divisions so far, not to the floristic region Praeillyricum, but through Transdanubicum to the flora sector Pannonicum. The district Zselic with the name Zselicense and the Villány Mountain with the name Villányense are treated as independent floral districts; for the latter Soó (Synopsis V, p. 532) would rather suggest the name Harsányicum. — It is still in the general part where the survey of the occurring plant associations has its turn. It appears that the author does not accept the category of division, his concept of federations (*Fagion-* or *Quercion*) is not consistent, and as regards the nomenclature his position is individual. The valid names of associations have been compiled by Soó (l.c. p. 695).

The specific part (pp 62–376) contains the tabular sampling material of the forest and free plant associations mentioned above, also their coenological evaluation, and their ecological (mainly pedological characterization as well, in an interpretation useful especially for those dealing with forest economy and forest typology. The numerous incorrect A–D values appearing in the tables do not diminish the value of the work, it is the basic samples here that are to be accepted as authentic. The good and coloured vegetation map on the scale of 1 : 50 000 shows the potential forest associations; the transposing of culture fir plantations and of *Robinia* groves may easily happen. Not accepting the rejection of the names of the regionally most considerable 3 forest associations in the Mecsek; the names of *Asperulo taurinae-Carpinetum*, *Helleboro odoro-Fagetum*, and *Tilio argenteae-Quercetum petraeae-cerris* are right on the basis of priority. It would have been reasonable to separate the acidophilous beeches from mesophilous beeches within the table. Unfortunately, as regards the spontaneity of *Castanea sativa*, the anthractomical results, not confirming the author's position, cannot be read (cf. VÉRTES, L., Acta Archeologica 1964, **16** 187–215).

In general this areal monography is thought-provoking, and stimulates further research. The oeuvre written on one of the most attractive regions of our country is an asset to our literature on botany. It is of use for both geobotanical and forestry specialists. The demanding layout (with the exception of the non-natural colours of the colour photographs) praises the Akadémiai Kiadó (Publishing House of the Hungarian Academy of Sciences). The continuation of the work in relationship to other regions, is eagerly awaited.

I. CSAPODY

HORTOBÁGYI, T., D. Sc. (Biol.): The Microflora in the Settling and Subsoil Water Enriching Basins of the Budapest Waterworks. Akadémiai Kiadó, Budapest 1973, 1—341 pp, 70 plates, 610 original figures

The work is important both scientifically and from a practical point of view. On the basis of comparative limnology, ecology and systematics, it provides detailed information on the microflora in the settling and subsoil water enriching basins of the Budapest Waterworks. This 341 page work, praising the elaboration with care by the Akadémiai Kiadó, represents great value not only in Hungary but it is also a significant asset of international algological literature.

The environment of man in our age becomes rapidly polluted. The problem of preventing our natural waters, especially our drinking waters, from eutrophization and from industrial pollutions presents no inconsiderable tasks in this field. To reveal water damages wrought by pollution the plant microorganisms are excellent indicators, their qualitative and quantitative analyses offering a picture of the extent of damage and at the same time offering some aid in the field of adaquate preventive measures. This is the overall project of the present work, too.

The results published here came into existence by means of modern investigative methods. From the relevant international literature, the author availed himself of 115 works, and by comparing the respective results with his own he attempted to present a picture of the functioning of the Waterworks which provides the water supply of our capital. The author briefly describes the production of water, the physical and chemical states of the basins, and in the light of these, he analyses the limnological and biological conditions of the basins. The water samples taken on 42 occasions in 1968—1969 represent all four seasons and provide a possibility to obtain a picture of the characteristic organisms of the individual basins, their seasonal occurrences, of the mass productions, of the morphological, ecological and cenological conditions, and of their use in saprobiological qualification.

In the taxonomical part, the author describes in detail the plant microorganisms, and he demonstrates every taxon with a figure illustrating the characteristic features. A total of 415 taxa have been found in the biotopes examined. They represent 116 genera. The number of excellent figures is 610, because many taxa are illustrated by several figures. — Earlier investigations (SZEMES 1967) of the Danube detected 1742 algal taxa. In comparison with these, the microflora of the basins, with their 415 taxa found, can be considered rich. It is worthy of noting ecologically that 238 of the 415 taxa detected in the basins have so far been unknown from the Danube; 13 species, 3 varieties and 26 forms (58 taxa) proved to be new to science.

From an ecological viewpoint, the author states that the physical characteristics of the water, deriving from the Danube into the basins, change favourably (the slowing down of motion, decreasing turbidity, better light and heat conditions, etc.) for some organisms, which thereby appear greater individual numbers than in the Danube. The number of individuals increases from the Danube through the settling to the end of the enriching basin. In this, besides the former physical conditions, the enriching caused by infiltration also play a part. The water of the basins is of a beta-mesosaprobic character. According to the author, 158 organisms can be considered saprobiologically. Among them, 65 are beta-mesosaprobionts, 3 oligosaprobions, 6 alfa-mesosaprobionts and 1 polisaprobiont. Again 15 taxa are relegable to the eurythermic organisms, and 37 to the stenothermic ones. Most of the organisms occurred during summer and autumn (347 and 326 taxa respectively), fewer in spring (60), and the least (25 taxa) in winter. Qualitatively the phytocoenoses of the basins is of a *Chlorophyceae* character, while quantitatively the *Cyanophyta* and *Bacillariophyceae* may temporarily come into the fore, and the former may cause algal blooms.

The value of the author's taxonomical investigations is increased by critical characterizations. We consider the examinations concerning parallel morphoses as of especially outstanding value. The morphoses observed in the *Chlorococcales*, and those observed recently, are classified into 17 types. By this means the existence of several debated taxa can be justified. The exploration of the observable convergencies therefore assists in general phylogenetical systemizing. The published ecological and coenological results in this field are also considered as mostly new.

The practical use of this work deserves also special appreciation. Today the opinion is becoming general that in the controlling work of waterworks, hydrobiological laboratory activities may also be useful, and occasionally even indispensable. In qualifying natural waters, in their saprobiological characterization, in the field of environment and nature protection, the hydrobiologist's work is of fundamental importance. In this work, the bioindicator algal organismus can be applied to merit. Hence the book in general assists in the work of waterworks by means of its accurate species descriptions, their excellent illustrations, and by the ecological

and coenological characterizations, while in the laboratory work of municipal waterworks it tills in a considerable gap. And it is a useful help for the algologist research worker as well as for the university or college teacher of a profounder interest in this field.

I. KISS (Szeged)

BRAUNER L., BUKATSCH, F.: Das kleine Pflanzenphysiologische Praktikum. 8th revised and enlarged edition. 352 pp, 157 figures; price: 29.80 DM. FISCHER Verlag, Jena.

A plant physiological practicum which has achieved its 8th edition hardly needs a special appraisal as the many thousand copies issued within the various editions testify the possibility and demand of proving phenomena in plant physiology on the one hand, and the necessity and value of the work at issue on the other hand. Naturally, since the first edition (1903) this work has been considerably transformed and expended, as entailed by the developments in methods and by the results in this particular field of science. This holds also for the preceding edition (1964), as is indicated in the introduction by Professor F. BUKATSCH who carried out the revision and supplementation of this work.

A survey of experiments in the several branches of plant physiology is provided in 10 parts, 267 experiments. The main chapters are as follows: 1. Soil as a substrate of plants; 2. Water content and mineral substances; water cultures; 3. Water uptake; transporters of nutrients; 4. Nutrient uptake and mineral assimilation in plants; 5. Carbon dioxide assimilation at light; 6. Analysis of organic materials (primary and secondary metabolism products); 7. Dissimilation; respiration and fermentation (processes); 8. Germination, growth (stimulating and active agents); 9. Movement and stimulus phenomena; 10. Survival and distribution of species.

Part Eleven contains instructions in carrying out experiments, and describes methods and instruments. It is also here that tables of data and values, which can be used in the experiments, are available, as well as equations of evaluation (e.g. error calculation).

Good arrengement of the material is promoted by several subtitles within the main chapters. At the beginning of the main chapters (before the various experiments), a shorter or a longer theoretical foundation is also laid by the author; for example, before the experiments in germination and growth, the structure and effect mechanism of the materials regulating the growth of plants are described briefly. This method of arrangement enables him to furnish information on the biochemical background of the experiments described, and to make them more fully understood, which is a great value of the work. It is also here that the relevent literature is found. The closing part is a subject index. The layout of the book is appealing.

The work surveys a large spectrum of plant physiological phenomena. This is one of its considerable merits, and it can only be welcomed that along with basic plant physiological experiments it has been enlarged with enzym activity experiments based on the latest results. We feel that it should further expand mainly in this direction, since the examination of, for example, auxin-oxidazes, NA-ases would be welcome at this point. It is also conceivable that the structure of DNA and RNA should also be demonstrated on plant material. Unfortunately, no information on experiments related to plant tissue cultures (mericlon techniques, organization examinations, protoplast cultures, etc.) is included in the book. Even so, the author's work helps considerably both secondary and higher (university) education in plant physiology, and it can be recommended to the attention of research specialists as well.

M. MARÓTI

MIKLÓS KEDVES: Paleogene Fossil Sporomorphs of the Bakony Mountains. Part I.—Studia Biologica Academiae Scientiarum Hungaricae. — Akadémiai Kiadó, Budapest 1973, 134 pp., with 12 figures, and 22 plates of photographs.

This work is the first part of the author's monograph written on the fossil sporomorphs of the paleogene remains in the Bakony Mountains. The work will be published in four parts — according to the plans — in this series. The present part gives — after an introduction — the detailed literary survey of paleogene palyneological works up to October 1969.

The data are made more complete complemented with a detailed bibliography.

A short survey follows on the material processed, and on the work of exploration. The taxonomical part contains the data of habitat of the spores that have already been described, and also the description of the new species. The author describes 26 new species. The figures show the morphological details conspicuously, the photo-plates are demonstrative. An index complements the work.

E. NAGY

EHRENDORFER, F.: Liste der Gefässpflanzen Mitteleuropas. Second edition, Stuttgart, G. FISCHER Verlag, 318 pages, mimeographed. 1973. 18 DM.

The Institute for Plant Taxonomy of Vienna began organizing the floristic mapping of the Central European "vascular" plants some 10 years ago (Taxon, **20**: 545—571, 1972). The first edition of the EHRENDORFER list (Vienna 1967) was launched also in this project. The compilers of the new edition — W. GUTERMANN and H. NIKLFELD — aimed at offering a nomenclaturial and floristical synopsis related to the region of "Central Europe" to be mapped (in which, to the already included four German-speaking states, the Western part of Chechoslovakia, NW Yugoslavia, the Northern part of Italy up to the river Po now also the Transdanubia is added). Thus the new edition contains the names of plant species and subspecies indigenous to the habitat, their essential synonyms and their areas (by the abbreviations of 7 state names). It summarizes the small species in agg.-s by drawing in some subspecies (unfortunately, also several which are characteristic to Hungary considered as less important by the authors).In general, the evaluation of the infraspecific units is not consistent (for example, subspecies in the *Centaureae*) but — rightly so — small species in the *Festuca*, and the chromosome number is not decisive either. Requested by Prof. EHRENDORFER, we have prepared in co-operation with A. BORHIDI and SZ. PRISZTER — the "Florenliste der westlichen Hälfte Ungarns" (1972, mimeographed); BORHIDI would be the organizer of the home work of mapping. Despite the fact that the names of all of us three, together with the names of several other authors appear on the cover of the new edition, the book frequently fails to take into consideration the statements of either the "Florenliste . . ." or of the Synopsis Florae Vegetationisque Hungariae (I—V, 1964—1973, short summary: Feddes Repert. **83**: 129—212; this is not cited, even though the author has seen the MS), or of other Hungarian authors. I have therefore included my critical remarks in the Supplements of the paper cited in the Repert. Concerning certain critical genera, probably no research works will be able to recognize the many included "small species" (e.g. in *Alchemilla*, *Hieracium*, *Rubus*). The book, with its summary of the latest results and with its occasionally debatable evaluations gives a truly good review of the taxa of the region.

R. Soó

FROEHNE, D. and JENSEN, G.: Systematik des Pflanzenreichs. Stuttgart, G. FISCHER Verlag, 305 pp, 1973

This book, titled "The Systematics of the Vegetable Kingdom", is in essence a textbook, giving less and at the same time more than is involved in the title. The part of general review, extending to 250 pages submits on 45 pages merely a brief draft of the cryptogams, less important from the points of view of chemical characteristics and agents, while the discussion of the 7th phylum, the *Spermatophyta*, is the first summary evaluation of all important results of chemotaxonomy. The work follows in full the system given in the 30th (last) edition of STRASBURGER's textbook (cf. Acta Bot. Hung. **18**: 431—432, 1973), which divides the plant kingdom into only 7 phyla (Abteilung), the *Spermatophyta* into 3 subphyla [*Coniferophytina*, *Cycadophytina* and *Magnioliophytina* (Angiosperms)]. This system is highly advantageous didactically, while nomenclatorially (mainly in the names of the classes) contradictory to the Code, and in many implications questionable phylogenetically. The authors — one of them is a pharmacologist — provide a modern and clear chemotaxonomical characterization of the units (subclasses, orders, families) discussed rather briefly morphologically (supplementing, as it were, the EHRENDORFER's elaboration in STRASBURGER). On the other hand, in the form of 32 so called structural plans (Bauplan), they demonstrate the structural characteristics of the more important orders in very illustrative drawings. As has been pointed out also by myself elsewhere (Soó: Synopsis florae vegetationisque Hungariae **5**: 521—532, Taxon 1975, in press), the occurrence or accumulation of certain secondary metabolic products (e.g. benzylisochinolin alkaloids in the *Magnoliidae*, betalains in certain *Caryophyllidae**, ellagic acid — the presence of which renders in my opinion rather doubtful, besides other reasons, a sharp separation of the subclasses *Rosidae* and *Dilleniidae* and iridoid compounds in several sympetalous and monocotyledonous orders) is indeed of great phylogenetico-taxonomical value, while the appearance of other substances is erratic, irregular, and the importance of many of them questionable. The authors offer in 210 formulae the structures of the more interesting compounds, as well as the biogenesis of many of them, with special emphasis on the agents occurring

* Systematists so far have failed to split the order *Chenopodiales*

in practice; they also give a special index of these and of drugs. However, the concise chemical and botanical "glossaries" do not make a thorough organic and biochemical as well as morphological and taxonomical knowledge indispensable for readers and students.

Hamamelidales, with its bisexual flowers (cf. taxonomic chart p. 91) and characteristic compounds (ibid., the last two passages), belongs rather in the subclass *Rosidae* (as in my book) and thus the subclass "*Hamamelididae*" begins with the order *Eucommiales*, — that is why in the Ref. the name *Eucommidae* is used — and it is placed as a considerably reduced branch of development after the *Caryophyllidae* (in EHRENDORFER's sequence); the authors of this book consider it the 2nd subclass. The last subclass, termed *Asteridae* by recent taxonomists (a large part of the former *Sympetalae*) is in my opinion not uniform, either in flower construction, or in chemism (cf. p. 175 the book), or in origin. The first orders (*Gentianales*, incl. *Rubiales*, *Dipsacales*, *Oleales*, and the *Polemoniales*, *Lamiales* and *Solanales* appearing as *Tubiflorae* s.l. with the authors) can be traced back to choripetalous *Rosidae* ancestors: iridoids are characteristic of these, while polyacetylens, phytomelans and inuline are absent; on the other hand, the latter are the products of the orders *Campanulales* and *Asterales* where in the iridoids are missing. I believe that the latter orders are the descendants of the *Dilleniidae* (*Malvidae* in my book) through the *Cucurbitales*. Three further sympetalous orders (*Ericales*, *Ebenales*, *Primulales*) belong also here — from TAKHTAHJAN to EHRENDORFER (and Soó 1973), but the authors of the present book relegate them to the *Rosidae*; I do not consider this well-grounded, and at the same time this is also one of the numerous uncertainties of the new system. In the monocotyledons, the subclass *Commelinidae*, rejected by EHRENDORFER and by me, is again included, rather on a morphological than a chemical basis, but the separation is not sharp here either.

Classes by the authors	Classes by the Reviewer
I. *Magnoliatae*	I. o. *Dicotyledonopsida*
1. subcl. *Magnoliidae*	1. subcl. *Magnoliidae*
2. subcl. *Caryophyllidae*	2. subcl. *Rosidae*
3. subcl. *Hamamelididae*	3. subcl. *Malvidae* resp. *Dilleniidae*
4. subcl. *Dilleniidae*	4. subcl. *Caryophyllidae*
5. subcl. *Asteridae*	5. subcl. *Eucomiidae*
II. cl. *Liliatae*	II. cl. *Monocotyledonopsida*
1. subcl. *Alismatidae*	1. subcl. *Alismatidae*
2. subcl. *Liliidae*	2. subcl. *Liliidae* (s.l.)
3. subcl. *Commelinidea*	3. subcl. *Arecidae*
4. subcl. *Arecidae*	

The excellent book substitutes for a whole library, especially for botanists, chemists, pharmacologists, and physicians. Its price is moderate (30 DM), its figures are excellent, its layout is exemplary.

R. Soó

KNAPP, R.: Die Vegetation von Afrika. (Vegetationsmonographien der einzelnen Grossräume III.) G. FISCHER Verlag, 1973. 626 pp. 823 figures, 238 DM.

This third volume of the series — already reviewed in our periodical — fits to the volumes dealing with North America and South America. It is similar also in layout, but its price threefold. KNAPP has led research trips in Africa for 10 years. He wrote his book surpassing even his former ones on the basis of these tours (there are several excellent photographs), and on using the cited (more than 1530) sources. He has taken into consideration environment culture, agriculture and forest economy with even greater care. He describes very many biocenoses (with original survey lists but without designation), and reviews the synecological bases, agricultural and forestry working methods, culture plants, and even the characteristic animals, in each habitat. A large part of the drawings (diagrams, area and vegetation maps, profiles, etc.) is also original. The main sections of the work are: Vegetation of the Zones of Tropical Rainforest and Related Forest Areas at Low Altitudes; Zones of Savannas and of Dry Deciduous Tree and Shrub Vegetation; Montane Vegetation in Africa South of the Sahara; Afroalpine Vegetation; Vegetation of Deserts and Subdeserts; Vegetation of Evergreen Sclerophyllous Zones and Adjacent Winter-rain Regions; The Vegetation of the Canary Islands, of the Cape Verde Islands and of Madeira. (The vegetations of Madagascar and the islands of the Indian Ocean are dealt with in connection with the corresponding zones of the continent.)

The book is useful and even necessary not only for geobotanists, ecologists, and geographers, but also for professionals in applied botany as well as for environment researchers. Unfortunately, it is hardly acquirable by home buyers. R. Soó

MÄGDEFRAU, K.: Geschichte der Botanik. Leben und Leistung grosser Forscher, Stuttgart, G. Fischer Verlag, 316 pp, 132 figures, 1973.

The author, a renowned paleobotanist, wrote a novel history of botany: he presents the development of botany through biographies of the great scientists and their followers, to the beginning of our century (only deceased research workers are included). He discusses the botany of the Antiquity and the Middle Ages (the first pictures are those of ARISTOTELES and THEOPHRASTOS); the "pater"-s of information on plants (the herbals); the origins of classification Linnaeus; the founders of the natural system from JUSSIEU to ENDLICHER (the only botanist born on Hungarian soil but who was an Austrian); then the first users of the microscope (the first workers of histology); the first physiologists from HALES to TREVIRANUS, the founders of phytogeography (from HUMBOLDT to CLEMENTS; the latter is the only one appreciated among the modern authors, although it was CLEMENTS who put forth the climax theory, now rather disputed); the students of plant sexuality, pollination and fertilization, from CAMERARIUS to NAVASHIN hardly any other Russian is mentioned, (e.g. KOSTITSEV); the theoretical and practical roads in the coguizame of plant morphology, from GOETHE to GOEBEL; the explorers of tissue structure and functioning, up to HABERLANDT; the renowned founders of cytology, from SCHLEIDEN to KÜSTER; the pioneers of ontogeny; the development of phylogeny only a brief discussion of WETTSTEIN and ENGLER, as the creators of systems, is given; American and Russian scientists, the pioneers of modern system are not mentioned; this is followed by a short outline of descent, species origin and plant farming; the founders of the new plant physiology (SACHS, PFEFFER); a few early masters of ecology (here appear the great figures of synecology: KERNER, WARMING, SCHIMPER); phytopathology (incl. bacteriology and mycology), and finally, paleobotany. This is perhaps the only descriptive approach accepted by the author as a science, and discussed more closely as his own. The notes contain extremely ample literature references, and even phytogenetical trees (pp. 255—299); here mention is made also of newer trends, so rather disapprovingly of "formalistic" sociology. Subjects like floristics, descriptive histology, morphology, taxonomy and similar others are not even mentioned. Thus the picture is a little one-aided, and all the more so as at least 80% of the discussed modern worker are German-speaking. Only a few of the greatest Anglo-Saxon and French scientists have also been included. Despite of all this, the book is delightful, with a good layout, and its price also moderate.

R. Soó

ANDY Z. LEHRER—MIHAI MITIUC: The Atlas of the Peronosporaceae in Romania. Dacia Publishing house.

This is the first areal and at the same time the first synthetic Romanian biogeographical work on a group of plants (the microscopic fungi) which are of a great scientific and economic value.

Conceived on the basis of the map-frawing system adopted for the great international floral and faunal projects, the work not only lists all the certain data concerning the *Peronosporaceae* in Romania. Thus offering an exact image of their special distribution, but also permits an integration of these data into the great scientific projects on European level.

The work proves the great importance of an international reference book (the map with the Universal Transverse Mercator network) in the biogeographic domain. in general, and simultaneously offers a precise areal representation on a national scale, eliminating thus the toilsome cartographic efforts of the classical system and offers the possibility of connecting all the Romanian phytogeographical data to the continental map.

The work comprises three sections:

1. An introduction in Romanian and English in which are explained the importance of the work in the context of international biogeographic projects, the method of using the maps, data concerning the history of the researches in Romania, of the spreading and importance of the group of phytopathogenic agents of the disease caused by the *Peronosporaceae* known under the denomination of "mildew".

2. An index of the species of *Peronosporaceae* in Romania.

3. The atlas proper, which contains 300 black-and-white maps with their special distribution in Romania. AL. CAPRARIU

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Von Dr. rer. silv. habil. EBERHARD NIEMANN, Jena

(Nova acta Leopoldina. Neue Folge. Suppl. Nr. 6. Bd. 38)

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